REPORT ON THE MINERAL EXPLORATION IN THE ZHAMAN-AIBAT AND SAMARSKY AREA REPUBLIC OF KAZAKHSTAN

(PHASE II)

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

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PREFACE

In response to a request from the Government of the Republic of Kazakhstan, the Japanese Government decided to conduct a Mineral Exploration Project in the Zhaman-Aibat and Samarsky Area and entrusted the survey to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

JICA and MMAJ sent to Kazakhstan a survey team headed by Mr. Akeo Onishi from 25 July, 1995 to 2 October, 1995.

The team exchanged views with officials of the Government of the Republic of Kazakhstan and conducted a field survey in the Zhaman-Aibat Area. After the team returned to Japan, further studies were made and the present report was prepared.

We hope that this report will serve for the successful development of the Project and will contribute to the promotion of friendly relations between our two countries.

We wish to express our deep appreciation to the officials of the Government of the Republic of Kazakhstan for their close cooperation extended to the team.

March, 1996

Kimio Fujita
President
Japan International Cooperation Agency

Shozaburo Kiyotaki
President
Metal Mining Agency of Japan

SUMMARY

The three year's mineral exploration program in the Zhaman-Aibat and Samarsky Area, Central Kazakhstan, was launched in 1994 with the aim of exploring mineral resources in these areas.

The primary aim of the program in this year was to evaluate the previous exploration data to confirm the geology of the ore deposit, to verify the occurrence of minerals and to evaluate the mineral deposit previously surveyed by the organization of the Kazakhstan Government.

In conjunction with these studies and evaluations, a secondary aim was to provide the staff of the Kazakhstan Government and of Kazakhstan private companies with the technology required to proceed with their daily works in these areas.

The work on the data analysis was concentrated in the Zhaman-Aibat Area and was done at Zhezkazgangeologiya joint stock company.

The study and evaluation included the following:

① review of the survey data,

② selection of the data required for ore reserve estimation,

③ compilation of survey data,

④ listing of previous survey data.

Based on the result of the study and evaluation of the previous exploration data, the data input of drillings and chemical assays was done and various maps and figures which are needed to estimate the ore reserve of the Zhaman-Aibat copper deposit were prepared. In the Zhaman-Aibat deposit, geological resource estimations (an ore reserve estimation) of the Eastern Orebody and main part of the Central Orebody were carried out. The results of the calculation by the Japanese survey team were compared to those of the Kazakhstan team and showed reasonable matching between two calculations.

For the purpose of obtaining geological and mineralogical data, one drillhole (MJK-1, drill lengths : 650m) was drilled in the Eastern Orebody and mineralized samples were used for an ore dressing test. The results will be utilized as the essential parameters for ore reserve evaluation scheduled in the Phase Ⅲ(1996).

The results of the survey and the evaluation are summarized as follows :

(1) In the Zhaman-Aibat copper deposit, a huge number of drillings (200m×200m grid pattern) have confirmed the area extent of the copper deposit and in-situ geological resources are able to be estimated. The estimated results of the geological resources both of the Eastern Orebody and the main part of the Central Orebody have showed slight differences in ore reserve and grade of ore compared to those results obtained by

Zhezkazgangeologiya. It is, however, not a significant problem at the present stages of resource evaluation i.e. geological resources estimation. At present, it is urgently desired to construct the Zhaman-Aibat data base of exploration data, especially drilling and chemical assay data.

(2) In order to re-evaluate the Zhaman-Aibat copper deposit, ore reserve estimation as minable reserve base is necessary in the early stage. Prior to the reserve estimation, the evaluation of the present drilling spacing will be studied by a geostatistical approach.

Additional works include the gathering of exploitation data from the Zhaman-Aibat copper deposit, including capital and operation costs, and the conceptual design of mine development. At that stage the ore reserve evaluation will finally be completed.

Based on the results, it is recommended that the following work be carried out in the 1996 (Phase II) campaign:

(1) Continuous survey and evaluation of the previous exploration data taken in the area of Zhaman-Aibat.
(2) Drillings both in the Central Orebody and Northern Orebody.
(3) Geostatistical study on the present drilling spacing.
(4) Conceptual design of mine development of the Zhaman-Aibat deposit.
(5) Minable ore reserve estimation.
(6) Economic study of the Zhaman-Aibat deposit.

Резюме

1. Результаты изысканий

По результатам изучения и анализа имеющихся данных, буровой разведки, исследования обогатимости руды Жаман-Айбат изучения технологии горных работ и стоимости разработки месторождения, Жезказаган были сделаны следующие выводы :

1) Геология рудных месторождений

(1)Жаман-Айбатское медное месторождение расположено в восточной части впадины Жезказган-Сарысу, на стыкеЧу-Илийского антиклинория с Бекейским глубинным разломом. С тектонической точки зрения месторождение приурочено к своду Жаман-Айбатской горст-антиклинали, простирающейся в субширотном направлении со средненадающим северным (20-45 град.) и пологим южным (до 5-10 град) крыльями.

(2)Стратиформное медное орудпение локализуется исключительно в сероцветных аллювиальных или дельтовых песчаниках в пределах "красноnесчаникового образования", которое по своему возрасту приходится между серединой / концом каменноугольного периода и ранней пермью.

(3)Результаты бурения свыше 825 скважин по сети 200 м х 200 м подтверждают, что здесь имеется три основных рудных тела, а именно, центральное, северное и восточное. Эти рудные тела распределены в пределах территории размером 12,5 км с запада на восток, и примерно 2-5 км с севера на юг. Глубина залегания рудного горизонта составляет приблизительно 350 - 500 м в восточной области, причем глубина растет по мере движения на запад. На западном краю центрального рудного тела она достигает 700 - 750 м.

(4)Рудные минералы в основном представлены халькозимом, джарлеитом дигенитом и борнитом в сочетании с небольшим количеством халькопирита, галенита и сфалерита. Встречаются также теннантит, самородное серебро, самородная медь, минералы группы герсдорфит-кобальтинов, а также ковеллин. По соотношению минералов различается четыре природных руд типа: медная (Cu), полиметаллическая (Cu+Pb+Zn), свинцово-цинковая (Pb+Zn) и серебряная (Ag+Cu).

(5)Состав минералов, текстура и структурные свойства породы и руды месторождения напоминают аналогичны Жезказганскому медному месторождению. В Жезказганском медном месторождении наблюдается 10 горизонтов минерализации в пределах серопесчаниковых отложении каменноугольного периода, причем, по оценке, 9 горизонтов обладают промышленными запасами руды. С другой стороны, в Жаман-Айбатском медном месторождении коммерческий интерес представляют 3 горизонта (2-й, 3-й и 4-й). В особенности богаты медью, свинцом, цинком и серебром горизонт 4-I и часть горизонта 3–VI с мощным рудным слоем, которые и представляют собой основную часть Жаман-Айбатского медного месторождения.

2) Оценка рудных запасов

Японская изыскательская группа второй год подряд ведет работу по оценке запасов руды (т.е. оценку геологических запасов) в восточном рудном теле и основной части центрального рудного тела. Результаты оценки были сравнены с данными, полученными "Жезказгангеологией". Расчет основывался на сведениях, введенных в базу данных по Жаман-Айбатскому медному месторождению. Совокупный объем введенных в базу данных составил 3 851 единиц от 402 буровых скважин. Из них для расчеты было взято 3 564 единиц данных от 302 скважин.

(1)"Жезказгангеология" классифицировала руды по четырем технологическим типам, а именно : медная руда, полиметаллическая (Pb+Zn+Cu), свинцово-цинковая и серебряная.

(2)Бортовое содержание составило : 0,4%Cu для медной руды, 0,8%(Pb+Zn) + 0,3%Cu для полиметаллической руды, 1,1%(Pb+Zn) для свинцово-цинковой, и 5гр./т Ag для серебряной руды.

(3)По результатам стратиграфического анализа горизонтов минерализации, условий залегания рудных тел, будущих горнорудных и рудообогатительных операций японская изыскательская группа пришла к заключению, что имеет место два типа руд, а именно : медная руда и полиметаллическая (Pb+Zn+Cu). Бортовое содержание составляет : 0,4%Cu для медной руды и 0,8%(Pb+Zn) + 0,3%Cu для полиметаллической. Таким образом, результат оценки ресурсов восточного рудного тела, полученный японской изыскательской группой, сравним с результатом "Жезказгангеологии".

(4)Метод расчета, примененный "Жезказгангеологией", представляет собой типовой метод, при котором перемножается площадь проекции на плоскость (в кв.м), средняя мощность (м) и средняя плотность руды (2,600).

(5)Японская же изыскательская группа использовала полигональный метод. Граница рудного тела в плоскости была оконтурена биссектрисами между точками расположения скважин в пределах рудного тела и скважинами, не пересекавшими рудное тело.

(6)Сравнивая геологические запасы восточного рудного тела, рассчитанные "Жезказгангеологией" и японской изыскательской группой, можно видеть, что в целом у японцев запасы получились больше, в то время как сортность руды оказалась ниже. Это обусловлено в основном расхождениями в методе определения руды и пустой породы и вовлечением дополнительных данных по недавним буровым работам.

(7)Площадь восточного рудного тела, рассчитанная японской группой, составила 8.747.002 кв.м (98,7% от 8.858.095 кв.м у "Жезказгангеологии"), причем средняя мощность равна 5,15 м (114,4% от 4,50 м). Вслед за этим, пользуясь данными о плотности (2,600, как и в "Жезказгангеологии"), был рассчитан общий запас руды, составивший 117.087.382 т (112,3% от 103.741.698 т). Таким образом, общий обьем металлической меди составил 1.596.560 т (105,9% от 1.507.290 т), при среднем содержании меди 1,36%Cu (93,8% от 1,45%Cu), и среднем содержании серебра – 10,78 гр/т Ag (91,4% от 11,8 гр/т Ag).

С другой стороны, результаты расчета японской группы по центральному рудному телу показали, что общий запас руды составил 35.105.542 т при средней мощности 4,71 м и среднем содержании 1,71%Cu, 1,04%Pb, 0,20%Zn и 10,75 гр/т Ag, соответственно. Из этого общего запаса резервы полиметаллической руды оценены в 17.599.690 т при средней мощности 5,77 м и среднем содержании 1,54%Cu, 1,77%Pb, 0,33%Zn и 10,94 гр/т Ag, соответственно.

3) Буровые изыскания

(1)В целях получения представительных образцов медной руды для геологический и минералогических исследований и проверки руды на обогащаемость, в восточном рудном теле была пробурена скважина МЖК-1. Осуществлялось типовое колонковое бурение со сьемным керноприемником при диаметре конечного керна 35 мм. Буровые работы продолжались с 13 по 25 августа 1995 г. Извлекаемость керна достигала 98,5% при зенитном угле искрывления ствола скважины от 0'30' до 1'15'.

(2)В целом, до отметки 415,5 м геология скважины МЖК-1 представлена красновато-бурыми песчаниками и алевролитами. В промежутке между глубинами 415,5 и 440 м наблюдается перемежение красновато-бурых и серых песчаников и алевролитов. Между отметками 440 и 618,75 м присутствуют серые песчаники. В наконец, от глубины 618,75 м вплоть до нижней отметки (650 м) преобладают красновато-бурые алевролиты и песчаники.

(3)Медное орудненне наблюдается между отметками 598,0 и 605,78 м. Длина орудненного керна составила 7,78 м при среднем содержании 3,78%Cu, 1,17%Pb, 0,03Zn и 22,7 гр/т Ag.

Рудный керн раскалывался пополам и одна половина отправлялась в лабораторию на анализ (химический, микроскопический, электронно-зондовый микроанализ), а другая – на испытание руды на обогащаемость.

4)Анализ горнорудной технологии и затрат в медном руднике Жезказган

Последней целью проекта являлось изучение и геолого-экономическая оценка Жаман-Айбатского медного месторождения. Чтобы собрать существенные данные, необходимые для определения промышленных запасов руды и составления концептуального плана будущей разработки месторождения. Проведено изучение эксплуатационных, технологических и затратных вопросов на руднике Жезказган, который морфологически и генетически аналогичен Жамап-Айбатскому месторождению. Ниже представлены результаты исследования :

(1)Акционерное общество "Жезказганцветмет" включает в себя четыре горнодобывающих компании и вовлечено в полный цикл технологических операций, начиная от эксплуатации рудников и кончая обогащением руды, плавкой и рафинированием. А/О было учреждено сравнительно недавно для целей работы в условиях рыночной экономики после разделения комбината, крупнейшего в бывшем СССР.

(2)В настоящее время в рамках "Жезказганцветмета" работает 31 тыс. человек в 14 компаниях : рудники, обогатительные фабрики, плавильные заводы, рафинирующие предприятия и т.д.

(3)Летом 1995 г. корпорация "Самсунг" приобрела права управления "Жезказганцветметом", обеспечив А/О оборотным капиталом и гарантировав его обязательства. Прежние финансовые трудности были разрешены и объем продаж "Жезказганцветмета" медленно возрастает.

(4)Жезказганское медное месторождение разрабатывается четырьмя акционерными компаниями, а именно "Восточный рудник", "Западный рудник", "Северный рудник" и "Южный рудник". Среди этих рудников 3 эксплуатируются методом подземной разработки. Северный рудник разрабатывается открытым способом.

(5)Добыча руды в 1995 г. составил 16 840 тыс.т при содержании меди 0,96%, в т.ч. 5 160 тыс.т при содержании меди 0,64 (для открытой разработки) и 11 680 тыс.т (69% от общей производительности) при содержании меди 1,10% для подземного способа разработки.

(6)Руды Жезказганского медного месторождения разрабатывается тремя подземными способами, а именно : группой камер, разделенных целиками; очистными выработками с целиками; послойными выемками. Такие методы разработки обусловлены морфологией и горно-геологическими особенностями рудного месторождения : мощностью (м), сортностью руды (%Cu), углом падения (град.) и характером руды и вмещающей породы. В случае, когда мощность слоя руды меньше 18 м и ее сортность ниже 2,5%Cu, внедряется метод разработки группой камер, разделенных целиками. Данный метод используется без заполнения и он отвечает за 75% общего объема выработки Жезказганского медного рудника. Метод очистных выработок с целиками внедряется в случае, когда сортность руды превышает 2,5%Cu. После этапа разработки группой камер, разделенных целиками, проводится заполнение, и через шесть месяцев приступают ко второму этапу с заполнением остатка.

(7)Степень извлечения весьма чувствительна к таким параметрам, как диаметр целика, ширина стенки выработки и глубина от поверхности. Используя формулу, разработанную московским институтом "Гипроцветмет", в случае слоя руды мощностью 6 м степень извлечения составляет 87,3%, 86,3%, 84,4% и 83,3% на отметках 200 м, 300 м, 400 м и 500 м, соответственно. Жаман-Айбатское медное месторождение находится на большей глубине, чем Жезказганское, что обусловливает более низкую степень извлечения на уровне 75,3% и 73,7% на отметках 600 м и 700 м, соответственно.

(8)Полученной информации и данных относительно эксплуатационных затрат недостаточно для детального анализа. Сметная стоимость подземной разработки в период с января по июль 1995 г. составила 413 тенге на тонну руды, или 6,7 долл. США (при курсе 60 тенге за доллар). В эти затраты входит стоимость разведки и транспортировки до бункеров вертикальных шахт. С другой стороны, сметная стоимость разработки открытым способом составляет приблизительно 260 тенге на тонну руды, или 4,3 долл.США.

5) Испытание руды на обогатимость

(1) Для испытания на обогатимость были взяты образцы с содержанием руды 1,69%Cu, 0,51%Pb, 0,03%Zn, 12 гр./тAg.

(2) Рудные минералы в основном представлены халькозином в сочетании с небольшим количеством борнита, галенита, пирита и с микроскопическим количеством халькопирита и сфалерита, и в общем были взяты мелкие частицы диаметром 1 – 500 мкм.

(3) Показатель работы оценивается равным 15,41 кВт•ч/т, что показывает твердоватую руду.

(4) При первичной флотации оптимальный размер составляет 64% с – 200 меш и время флотации – 10 минут.

(5) При избирательной флотации изопропилксантогенат натрия подходит как выноситель и железистосинеродистый калий – как депрессант меди.

(6) При усиленном измельчении происходит повышение эффективного коэффициента выхода свинца и меди, однако, чрезмерное измельчение приводит к снижению эффективного коэффициента выхода свинца.

(7) При интегральной избирательной флотаци был получен медный концентрат 39%Cu, 1%Pb с эффективным коэффициентом выхода

меди 86% и свинцовый концентрат 48%Pb, 11%Cu с эффективным коэффицентом выхода свинца 67%.

(8) При прямой избирательной флотации был получен медный концентрат 30%Cu, 3%Pb с эффективным коэффицентом выхода меди 85% и свинцовый концентрат 59%Pb, 10%Cu с эффективным коэффицентом выхода свинца 64%.

(9) Если сравнить интегральную и прямую избирательные флотации, с точки зрения производства цели выгодна интегральная избирательная флотация и с точки зрения производства свинца – прямая избирательная флотация. Исходя из экономического соображения, интегральная избирательная флотация для производства меди становится выгоднее, и поэтому она была выбрана как оптимальная схема флотации.

(10) Кроме медной руды, для которой проведено испытание на обогатимость, также имеются в наличии полиметаллическая (Pb + Zn + Cu), медно-серебряная и другие руды, и поэтому для них также необходимо провести испытание на обогатимость.

2. Рекомендации к изысканиям III фазы

На основании результатов этого года, рекомендуется провести следующие изыскательские работы в ходе III фазы (1996 г.) :

(1) Анализ и оценка предшествующих данных, в особенности оценка данных по центральному и северному рудным телам, и в целом по трем рудным телам.

(2) Буровые изыскания

Рекомендуется провести бурение для получения исходных данных и образцов руды для испытания на обогатимость : в центральном рудном теле для полиметаллической руды и в северном рудном теле для медно-серебряной руды.

(3) Испытание на обогатимость

Используя образцы рудного керна полиметаллической и медно-серебряной руды, планируется провести испытания руды на обогатимость в целях определения базовых параметров рудных запасов.

(4) Оценка рудных запасов

1. изучение существующего интервала бурения с точки зрения геостатистического подхода.
2. исследование капитальных и оборотных затрат
3. расчет промышленных запасов руды

4.разработка концептуального проекта и экономического обоснования по Жаман–Айбатскому руднику.

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GENERAL

PART I GENERAL

Chapter I Introduction

1-1 Circumstances of Survey

The main objective of this survey is to explore and evaluate mineral deposits of the survey area, as mentioned in the Scope of Work for the Mineral Exploration in the Zhaman-Aibat Area (Figure 1-1-1). The Scope of Work was agreed on December 29, 1994 between the Government of Kazakhstan through the Ministry for Geology and Conservation of National Resources (MFG), and the Japan International Cooperation Agency (JICA), and the Metal Mining Agency of Japan (MMAJ).

The present survey is a three-year project which commenced in the fiscal year of 1994, and this year is the second year (Phase II) of the project.

The programme of the first year included data analysis and evaluation of previous survey data of the Zhaman-Aibat Area and the Samarsky Area, and confirmed the geological setting and mode of occurrence of the ore deposits and re-evaluated previously surveyed deposits. In the Zhaman-Aibat Area satellite image analysis revealed lineaments and geological structure and extracted alteration zones within the deposit.

This year, the 2nd year of the project, the survey has concentrated on the Zhaman-Aibat Area and more detailed surveys were conducted. That is, the previous survey data obtained during the 1st year (Phase I) and this year, were analyzed and a part of the ore reserves of the Zhaman-Aibat copper deposit were evaluated. In order to gather the data, such as stratigraphy of the lithofaces and to confirm the mode of occurrence of the mineral deposits, a drilling survey was conducted. The recovered mineralized drill cores were used for ore dressing tests and an appropriate ore dressing process was examined.

1-2 Conclusion and Recommendation for Phase II

1-2-1 Conclusion of Phase I

The result of the first year led to the following conclusions;

(1) The Zhaman-Aibat copper deposit and the Samarsky copper-molybdenum, and gold-bearing polymetallic deposits represent resources that are essential to the economy of the Republic of Kazakhstan. It is recommended to proceed not only with the

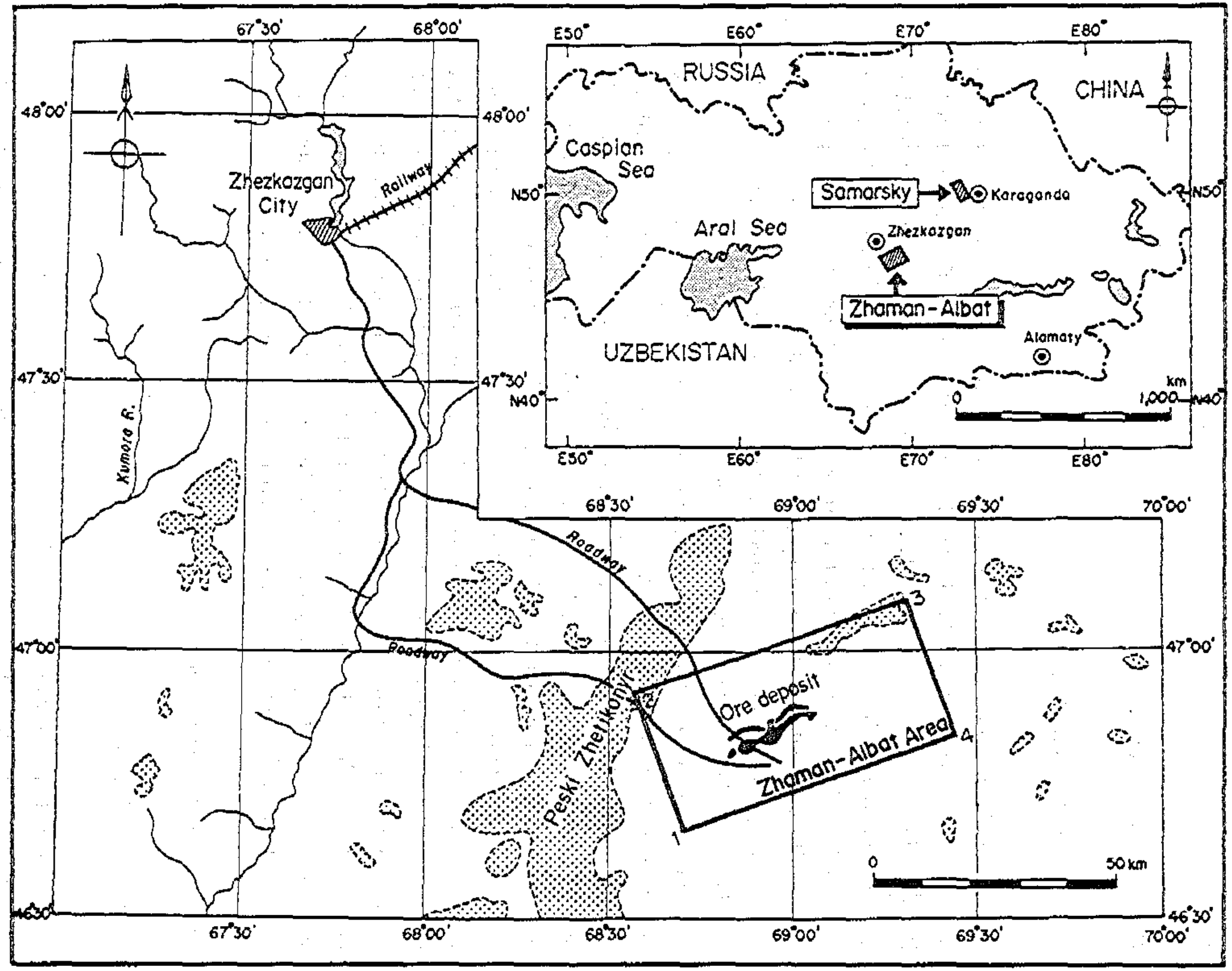


Figure 1-1-1 Locational Map of the Zhaman-Aibat Areas

exploration of new ore deposits but also the evaluation of the known, unexploited deposits.

(2) The Zhaman-Aibat copper deposit is a type of stratiform copper deposit ,and has many analogies to the Zhezkazgan copper deposit. Thus, it is recommended that experience gained at Zhezkazgan be used in studying the appropriate drilling interval, future mining method be studied and the chemical assay methods and results at an early stage before the evaluation of the deposit scheduled in 1996.

(3) At present, all works from assay data sheet preparation to the ore reserve estimation are done by hand and produce several data sheets. Errors, omissions and inconsistencies in the hand written data sheets reduce the reliability of each data .It is recommended that a computer system be adopted for the management of exploration data.

1-2-2 Recommendation for Phase II

Based on the results of Phase I , the following exploration tasks were recommended for comparison with the 1995 results;

(1) to study and to evaluate the previous survey data, it is recommended that data on the Eastern and Central orebodies be evaluated in the Zhaman-Aibat copper deposit in particular.

(2) to gather the basic geological, mineralogical and ore dressing data, it is recommended that exploration holes be drilled in the Zhaman-Aibat Area .

(3) to start the construction of a data base for the evaluation of the Zhaman-Aibat copper deposit, In Phase II (1995), data of the Eastern and Central orebodies should be inputted and ore reserves (resources base) should be estimated.

1-3 Outline of Phase II Survey

1-3-1 Survey Area

The Zhaman-Aibat copper deposit area is located in the Zhana-Arkin district of the Zhezkazgan region in Central Kazakhstan. Geographic coordinates are 46° 50' north and 68° 54' east (Figure 1-1-1). The Zhaman-Aibat copper deposit area can be accessed by car from Zhezkazgan via the Zhezkazgan-kzyl-Orda highway and unpaved roads. The nearest railway station is the Zhezkazgan station 180km to the northwest of the deposit.

1-3-2 Objective of the Project

The main objective of the project is to assess the mineral potential of the Zhaman-Aibat Area. The objectives of Phase II are to carry out more detailed surveys than in Phase I and to re-evaluate the Zhaman-Aibat copper deposit. The project's final goal is to contribute to the development of the mineral deposit and to transfer technology to the staff of the Kazakhstan Government and of Kazakhstan private companies.

1-3-3 Method of Survey

(1) Data collection, data analysis and data evaluation

During this year's campaign, previous survey data on geology and ore deposit were collected and analyzed. This year, detailed data in the reports, such as exploration, ore dressing test and ore deposit was evaluated. These data are shown in Table. 1-1-1.

(2) Drilling survey

In the Zhaman-Aibat copper deposit, drilling points were selected where the characteristics of the Eastern orebody, such as the thick mineralization and high copper grade were expected. Drilling specifications are planned as :

Name of drilling	: MJK-1
Total drill length	: 650m
Inclination	: vertical (-90°)
Duration of drilling	: from August 10, 1995 to August 30, 1995
Depth of mineralization	: approximately 600m
Thickness of ore zone	: approximately 10m
Mineralization	: copper ore composed mainly by chalcocite

Mineralized drill cores were sketched and documented. Laboratory and ore dressing tests were carried out and confirmed several important parameters for the ore reserve evaluation.

(3) Laboratory Tests

By using drill cores, basic laboratory tests were carried out as shown in Table 1-1-2.

(4) Ore dressing

Mineralized cores recovered from MJK-1 were tested by the floatation method as shown in Table 1-1-3.

Table 1-1-1 List of Previous Survey Data during this Year's Campagne

Description of Materials	scale
Geological Map (Revised)	1 : 50,000
	1 : 25,000
Geologic Cross-Section	1 : 5,000
	1 : 2,000
Drill Location Map	1 : 25,000
Ore Block Map of Deposit (Horizon 4- I)	1 : 10,000
	1 : 5,000
Geophysical Survey Map	
Magnetic Anomaly	1 : 100,000
Gravity Anomaly	1 : 100,000
Electrical Exploration Map	1 : 100,000
Geochemical Map	1 : 100,000
Cross Section of Metal Contents and Lithostratigraphy	1 : 20
Copper Mineral Assembledge Map	1 : 25,000
Geological Columb Section of Drill Holes	1 : 200
Drill Hole Inclination Data	1 set
Report on Ore Dressing Tests	2 reports

Table 1-1-2 Laboratory Tests and Works

Items	No. of samples	Elements
Chemical analysis	80 samples	9 elements (Au,Ag,Cu,Pb,Zn,Re, Fe^{++},total Fe,S), total 720 components
Whole rock chemical analysis	5 samples	12 elements (SiO_2,TiO_2,Al_2O_3, Fe_2O_3,FeO,MnO,CaO,Na_2O, MgO,K_2O,P_2O_5,LOI)
Microscopic observation of rocks in thin section	5 samples	
Microscopic observation of ore minerals in polished section	8 samples	
Electron microprobe analysis of ore minerals	3 samples	
Check analysis of previous assay samples	36 samples	5 elements (Au,Ag,Cu,Pb,Zn), total 180 components

Table 1-1-3 Ore Dressing Tests : Detailes of Tests and Analyses

Item	Tests and analyses	Times	Number of samples	Total number of analyses
Phisical analyses				
	① Mesurement of work index	1	1	1
	② Microscopic observatioon of polished ore	…		3
	③ Chemical analyses of ore (19 elements;Cu,Pb,Zn,Fe, S,Sb,As,Bi,Cd,Hg,Au,Ag, Re,SiO_2,Al_2O_3,MgO,CaO, K_2O,Na_2O)	…		1
	④ Power X-ray diffractometer analyses of ore	…		1
Preliminary metallurgical tests				
Grinding tests	① Chemical analyses (3 elements; Cu, Pb, S)	3	5 (5 size ranges)	15
Roughing flotation tests(Bulk flotation)	① Chemical analyses (2 elements; Cu, Pb)	3	4	12
Kinetic flotation tests	① Chemical analyses (3 elements; Cu, Pb, S)	2	5	10
	② Chemical analyses (Bulk conc. :5 elements; Cu, Pb, Zn, Fe, S)	…	…	1
Straight differential flotation tests (Comparing test)	① Chemical analyses (2 elements; Cu, Pb)	3	4	12
Particle size analyses of flotation tailings	① Chemical analyses (2 elements; Cu, Pb)	3	5 (5 size ranges)	15
Differential flotation tests				
Cleaning flotation tests(flotation size)	① Chemical analyses (2 elements; Cu, Pb)	3	4	12
Cleaning flotation tests(reagents)	① Chemical analyses (2 elements; Cu, Pb)	4	4	16
Confirmation tests (Flotation conditions)	① Chemical analyses (2 elements; Cu, Pb)	4	5	20
	② Microscopic observation of polished ore (Cu conc., Tailing)	…	…	3
	③ Chemical analyses of conc. (Cu conc., Pb conc. 21 elements : Cu,Pb,Zn,Fe, S,Sb,As,Bi,Cd,Hg,Au,Ag, Cl,F,Re,SiO_2,Al_2O_3,MgO, CaO,K_2O,Na_2O)	…	…	2

(5) Data base construction for ore reserve estimation

A total of approximately 400 drill holes data and approximately 3,900 points of chemical analysis data were inputted to the Zhaman-Aibat deposit data base (Table 1-1-4).

Table 1-1-4 Amount of Input Data to the Zhaman-Aibat Data Base

Drilling summary

Period of drilling	: 1981~September 1995
Total number of drill holes	: 825+171 (technical drilling)
Total length of drill	: 632,467.4 m

Input data to data base

Numbers of drill holes	: 402
Numbers of samples	: 3,851
Parameters	: drill number, coordinates (X,Y,Z), drill length (m),
	: drill hole inclination (degree), chemical assay data
	: (Cu,Pb,Zn,Ag), ore horizon

Data used for ore reserve estimation

Name of orebody	Central Orebody	Eastern Orebody
Number of drill holes	207 holes	95 holes
Number of data	2,381 points	1,183 points
Chemical assay data	Cu,Pb,Zn,Ag	Cu,Pb,Zn,Ag

1-3-4 Members of the Survey Team

Members of Japanese survey team and the staff of the Kazakhstan Government and of Kazakhstan private companies that participated in the survey are shown in Table 1-1-5.

1-3-5 Survey Duration

For the second year's campaign, the survey work commenced on June 01, 1995 and was completed on February 29, 1996.

Table 1-1-5 Member List of the Survey Team

Japanese Survey Team

Mr.Akeo Onishi (Leader,Sumiko Consultants Co.,Ltd)
Mr.Takaaki Nagao (Sub-leader,Sumiko Consultants Co.,Ltd)
Mr.Yoshio Takeda (Sumiko Consultants Co.,Ltd)
Mr.Akihiko Murase (Sumiko Consultants Co.,Ltd)
Mr.Sumio Kudo (Sumiko Consultants Co.,Ltd)

Kazakhstan Survey Team

◆A.O.Zhezkazgangeologiya
Mr.Khuseinov Zh.I. (President)
Mr.Ospanov U. O. (Vice-President)
Mr.Kasimovski P. A. (Vice-President)
Mr.Kazimir V. T. (Chief Geophysicist)
Mr.Ospanov K.S.(Production Manager)
Mr.Uzhva V. I. (Chief Geologist of Zhaman-Aibat Party)
Mr.Cheglakov A.I.(Chief Engineer)
Mr.Baimaetdinov E.B.(Head of Zhaman-Aibat Party)
Mr.Shingisov A.U.(Chief Engineer of Zhaman-Aibat Party)
Mr.Nisambaev A.O.(Drilling Master)

◆A.O.Zhezkazgantsvetmet
(Head Office)
Ms.Ibraeva G.N.(Manager of Planning,A.O.Zhezkazgantsvetmet)
Mr.Gennadi P.(Manager of Development,A.O.Zhezkazgantsvetmet)
Mr.Tanenov T.I.(Chief Geologist,A.O.Zhezkazgantsvetmet)
(East Mine)
Mr.Uruymov B.A.(Mine Manager)
Mr.Sopoviev C.H.(Production Manager)
(South Mine)
Mr.Biljanov A.(Technical Manager)
(North Mine)
Mr.Kozhubayev M.K.(Chief Engineer)
Mr.Irzhanov A.(Assistant Production Manager)
Mr.Ikonnikov G.(Chief Geologist)
(Research Center)
Mr.Kunashbaev S.(Vice President)
(No.1 & 2 Mill)
Mr.Tokbulatov T.(Chief Engineer)
Mr.Volyada V.(Production Manager)

Planning and preparation	: from June 01, 1995 to July 24, 1995
Preparation and data collection in Almaty	: from July 25, 1995 to August 09, 1995
Data collection and analysis	: from August 10, 1995 to August 11, 1995
Drilling survey	: from August 12, 1995 to August 27, 1995
Data collection and analysis	: from August 28, 1995 to September 29, 1995
Reporting	: from September 30, 1995 to October 02, 1995
Data analysis, preparation of annual report	: from October 03, 1995 to February 29, 1996

Chapter 2 Geography of Survey Area

2-1 Physiography

The Zhaman-Aibat copper deposit area is located in the Zhana-Arkin district of the Zhezkazgan region, 180 km to the southeast of Zhezkazgan in Central Kazakhstan. The topography of the area is characterized by hummock relief with relative elevations up to approximately 30m. The altitude of the Zhaman-Aibat copper deposit area is approximately 320～380m above sea level. The highest point in the area of the deposit is 376.7m in altitude and the lowest point is 318.0m. There are few permanent water courses and the only depressions in the area are between adjacent hills, which channel melted snow and rarely rain water during spring.

2-2 Climate and Vegetation

The climate of the area is of an extreme continental type with severe cold winters and dry hot summers and is classified as a zone of dry feather-grass steppe. The average annual temperature in the area is +5.5℃ with average monthly summer temperatures up to +33℃. In winter the temperature falls to -33℃ (Table 1-2-1). The highest temperature reaches +43℃ in summer and the lowest, -50℃ in winter. Total annual precipitation does not exceed 200 mm. During winter, the thickness of snow cover reaches 40～50 cm. Vegetation corresponds to the semi-desert type and is very thin. The surface of the ground is rarely covered by xerophytic vegetation in the summer season. The major vegetation is feather grass, sagebrush and other groups of grasses.

Table 1-2-1 Climatological Data of the Zhezkazgan and Zhaman-Aibat Area

(Zhezkazgan City)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul	Aug	Sep	Oct	Nov.	Dec.	Ave. /Total
Average Temperature (℃)	-16.0	-11.6	7.2	6.2	15.5	21.6	24.0	21.4	14.4	4.8	-5.1	-12.8	5.5
Precipitation (mm)	13	12	14	14	11	17	16	11	8	12	10	12	150

Maximum Temperature 43.0 ℃
Minimum Temperature -50.0 ℃

Average annual precipitation : 150 mm
Precipitation occur during summer months (June-August)
Total snow covered days 120 - 150 days

(Zhaman-Aibat Exploration Camp)
Monthly average temperature in June - July 33.0 ℃

Chapter 3 Previous Work

In this year's campaign, collection and compilation of the previous exploration data were carried out. In order to interpolate the regional geological structures, geological and geophysical data were re-evaluated. Based on the results of the study and evaluation of the previous ore dressing test results and ore deposit evaluation data, several important parameters were documented for the ore reserve evaluation.

3-1 Outline of Geological Surveys

(1) Geological surveys

Systematic geological works started in the 1920's. During 1959～1964, exploration parties drilled in the Zhaman-Aibat Area and confirmed copper mineralization at the depth of 400～700m with thickness of 0.4～1.0m and copper grade 1.16～1.30%. Since 1981, essential exploration for copper has been carried out by the Zhezkazgan Exploration Party on the eastern flange of the Zhezkazgan-Sarysu depression and has confirmed the existence of a commercial grade copper deposit. From 1981 to October 1995, a total of 996 holes, including 825 holes for exploration and 171 holes for geotechnical sampling, were drilled.

(2) Geochemical surveys

Geochemical surveys have resulted in delineating mono-element and complex halos of scattering of chemical elements. Four large halo areas, namely Taskura, Zhaman-Aibat, Azat and Zhatyka were delineated.

(3) Geophysical surveys

In the Zhaman-Aibat Area, systematic reconnaissance surveys were carried out in the

1950's. Since the 1970's, surveys such as airborne magnetic, ground magnetic, gravity, seismic (reflection wave) and electric (SP, VES, IP and TEM) methods have been utilized. Among these, seismic surveys seem to be the most useful in this area taking advantage of good reflections in a subsurface metalliferous-Carboniferous layer. Electric IP is not appropriate in this area, where the ore horizon is beyond the detection depth.

3-2 Geologic Setting

The area is located on the eastern flank of the Zhezkazgan-Sarysu depression in the southwestern part of Central Kazakhstan. The geologic formations of the area range in age from the Cambrian to the Quaternary, and include sedimentary, igneous, plutonic, metamorphic rocks and younger sediments (Figure 1-3-1).

Cambrian rocks are found in the northwestern area in the Ultau anticlinorium area and correspond to gneissose and granitic rocks.

Ordovician rocks are distributed in the northeastern part of the area and are mainly sandstones and shales with lenses of limestone.

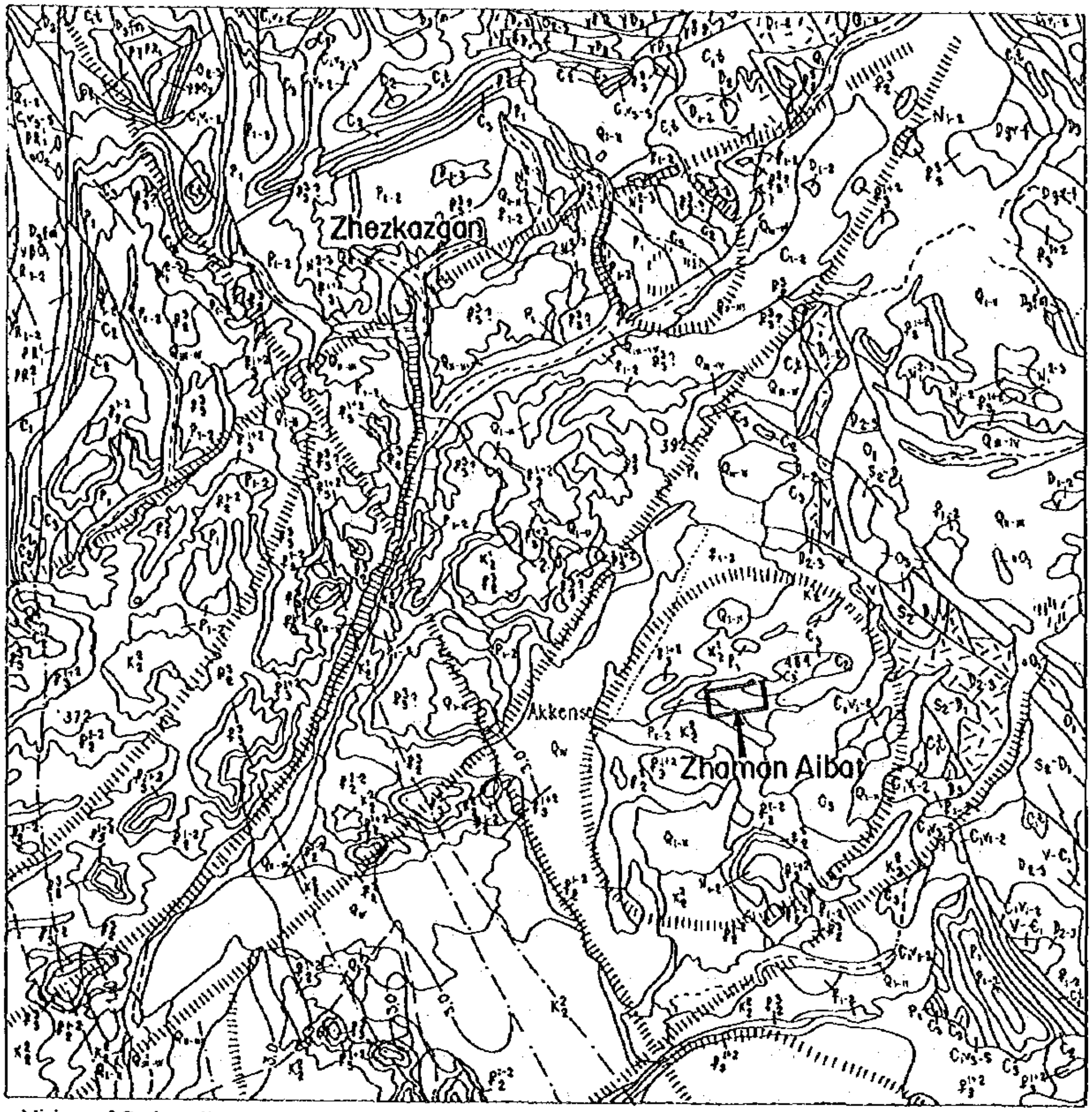
Devonian formations are widely distributed in the northeastern area. A thick layer of conglomerate occurs at the basement, and sandstone, aleurolite (siltstone) and lenses of limestone occur in the upper part of the formation.

Rocks of the Carboniferous system are widely distributed in the area. Carbonate and terrigenous complex of marine sediments are referred to as the lower and a complex of various sediments of continental origin is referred to as the middle. The group of sediments deposited under the evaporative environment is referred to as the upper Carboniferous. The copper mineralization of the Zhezkazgan and the Zhaman-Aibat deposit is associated with a continental alluvial and deltaic red-colored sandstone sequence ranging from middle to late Carboniferous and lower Permian in age (Figure 1-3-2).

Permian sediments mainly composed of terrigenous with high carbonate content, are widely distributed and are represented by red-colored sandstone and evaporite in the lower and limy sandstone faces with marl in the upper portion.

Mesozoic and Cenozoic sediments are widely distributed over the whole area and are represented by siltstone, sandstone and clay.

Intrusive activities in the Cambrian and Ordovician ages are mainly limited to plutonic rocks and their distribution are observed in the Kengir brachy-fold zone. Devonian volcanic and intrusives recognized in the northern to northeastern area are characterized by high variability of faces.



Ministry of Geology (1982)

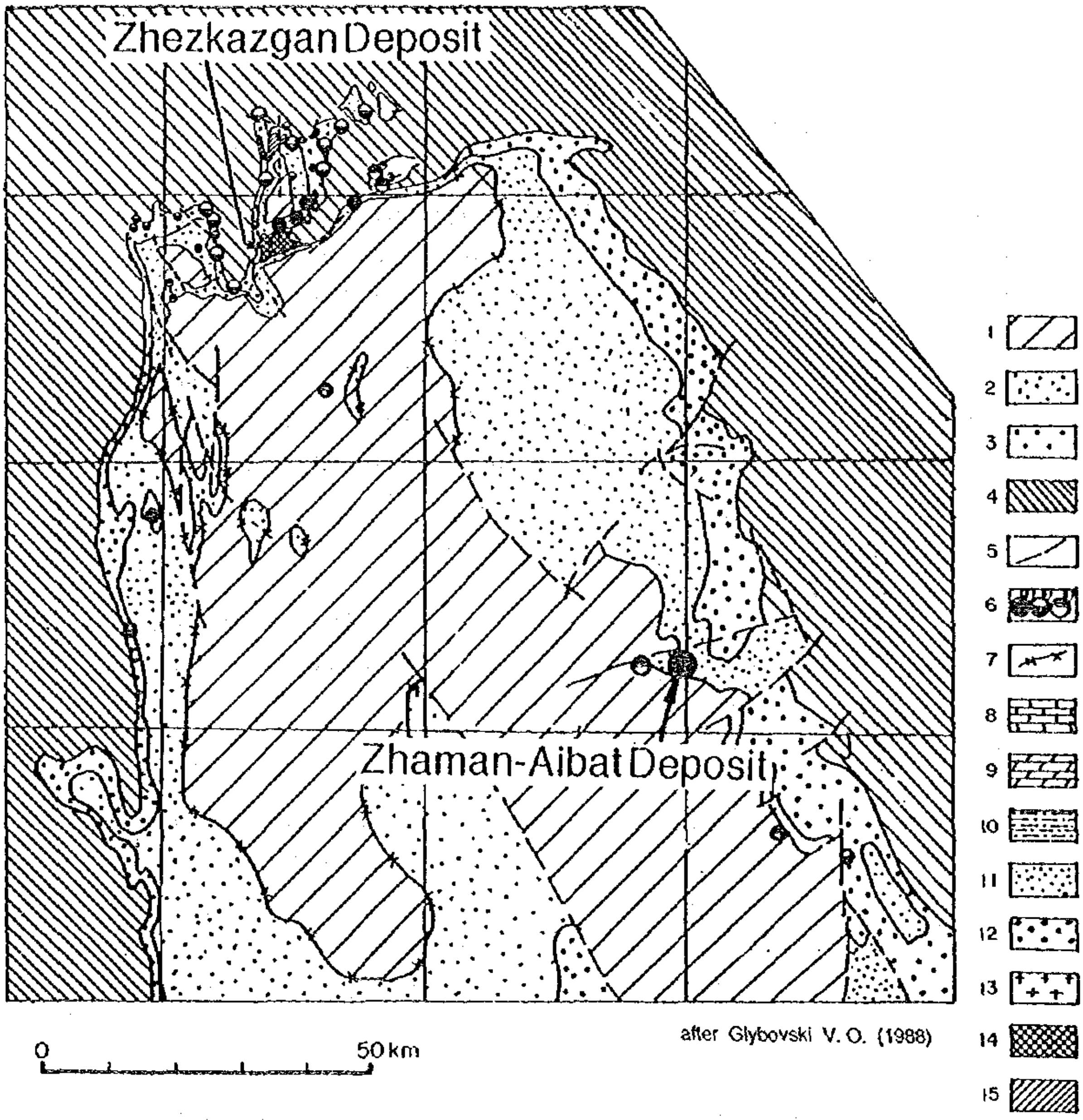
0 15 30 45 60 75 km

LEGEND

Qı' IY	Quaternary
Nı' 2	Neogene
Pı' 3	Paleogene
K	Cretaceous
Pı'2	Permian
C3	Upper Carboniferous
C2	Middle Carboniferous
CıV-3	Lower Carboniferous; Serpukhov Stage
D	Devonian
S	Silurian
O	Ordovician
Є	Cambrian

- Boundary of formation
- Boundary of contemporaneous meteropic facies
- Boundary of tectonic zone
- Thrust fault
- Equi-contour line of base of blanket layer
- Tectonic zone
- γβ Gabbro
- δ Serpentinite, dunite
- β Diabase, diabase-porphyry
- Acidic efusive rocks
- Intermediate efusive rocks
- Zhaman-Aibat Area

Figure 1-3-1 Regional Geological Map of the Zhaman-Aibat Area



1 Grey marl deposition of Permian
2 Red rhodusite-gypsum-salt-bearing formation of evaporite type of lower Permian
3 Cuprous red formation of middle and upper Carboniferous
4 Grey terrigenous-Carboniferous depositions of lower Carboniferous
5 Tectonic dislocation
6 Type of mineralization of cuprous sandstone (a-Zhezkazgan type, b-Zhilandin type, c-Mansfeld type)
7 Cuprous stratum of Mansfeld type
8 Limestone including flints
9 Marl
10 Aleurolite and argillite
11 Sandstone
12 Conglomerate
13 Gypsum and salt
14 Zhezkazgan type deposit (actual mining or exploration completed)
15 Zhilandin type deposit (exploration completed)

Figure 1-3-2 Regional Distribution of Stratiform Copper Deposit in the Zhezkazgan-Sarysu Depression

3-3 Outline of Ore Dressing Test

Oredressing tests, using mineralized drill core samples were carried out by institutes of the former USSR. However, most of the tests were done not for the purpose of studying ore-dressing for the future operation, but only for the trial of new technology. That is, input ore types for ore dressing tests varied from copper ore, complex (Cu+Pb+Zn) ore, zinc ore, lead-zinc ore, silver ore and silver-copper ore. In addition, chemical grades, such as Cu(%), Zn(%), Pb(%), Ag(g/t) are discrepant from the actual oredressing operations. Therefore the results of their tests will be treated as reference data only.

Chapter 4 Survey Results

The results of the study and evaluation of the previous data, drilling surveys and surveys of mining technology and mining costs, have concluded in the following :

4-1 Geology and Ore Deposit

(1) The Zhaman-Aibat copper deposit is located at the eastern edge of the Zhezkazgan-Sarysu depression, close to the junction with the Chu-Ili anticlinorium at the Bekei deep-seated fault (Figure 1-4-1 and Table 1-4-1). From the standpoint of tectonics, the area of the deposit is related to the axial zone of the Zhaman-Aibat horst-anticline, extending in sub-latitudinal direction with steep northern (20~45°) and gentle southern (up to 5~10°) limbs.

Table 1-4-1 Characteristics on Each Orebody in the Zhaman-Aibat Ore Deposit

Orebody	Eastern	Central	Northern
Depth(m)	380~660	600~700	500~800+
Dimension E-W(m)×N-S(m)	7500×(1500~2000)	5500×1500	(500~2000)×(100~700)
Main ore horizon	4-I	4-I	4-I
Thickness(m)	4.5~5.5	4~6	5~5.5
Main ore type	Cu ore	Complex ore, Cu ore	Cu-Ag ore

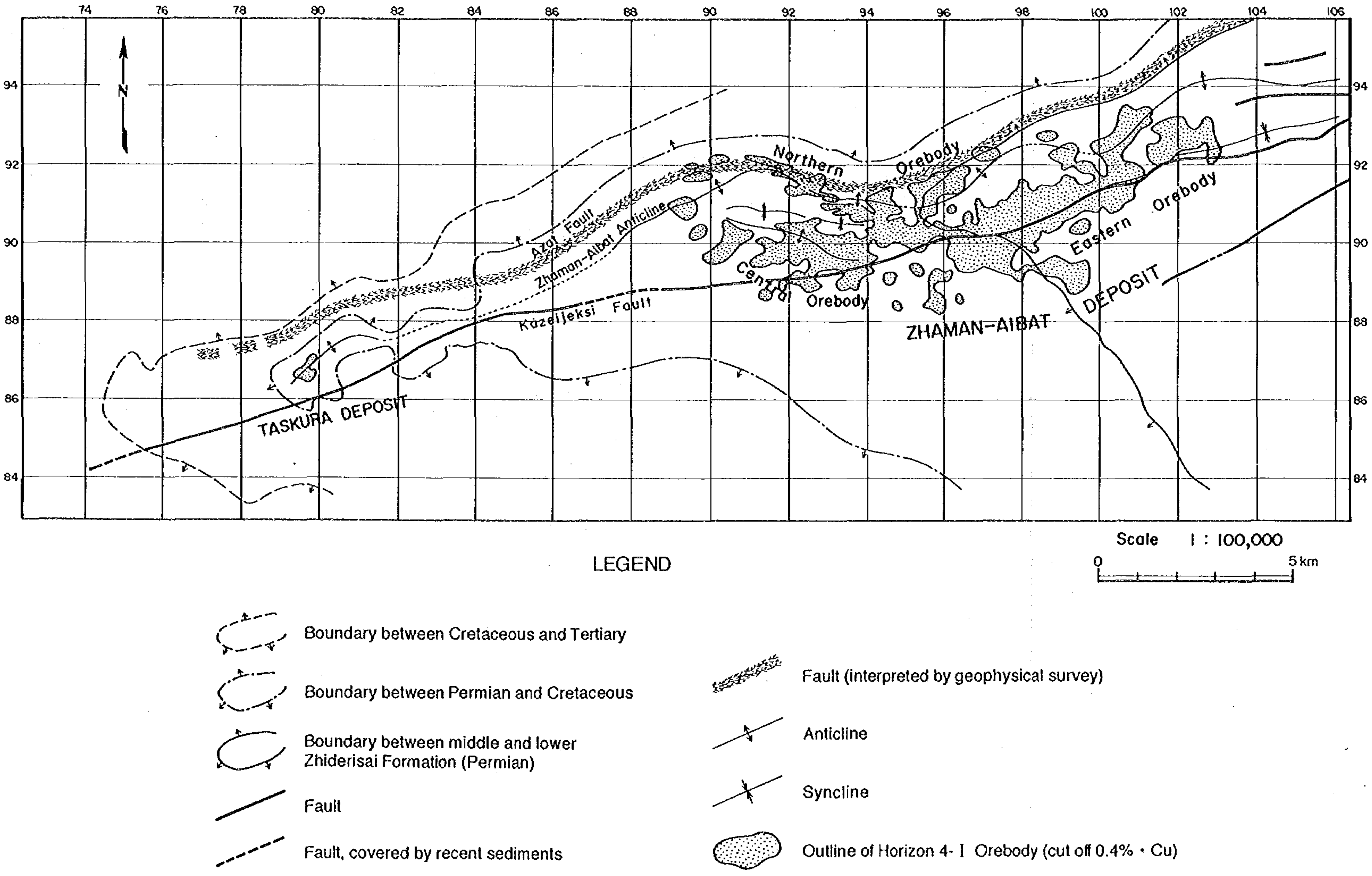
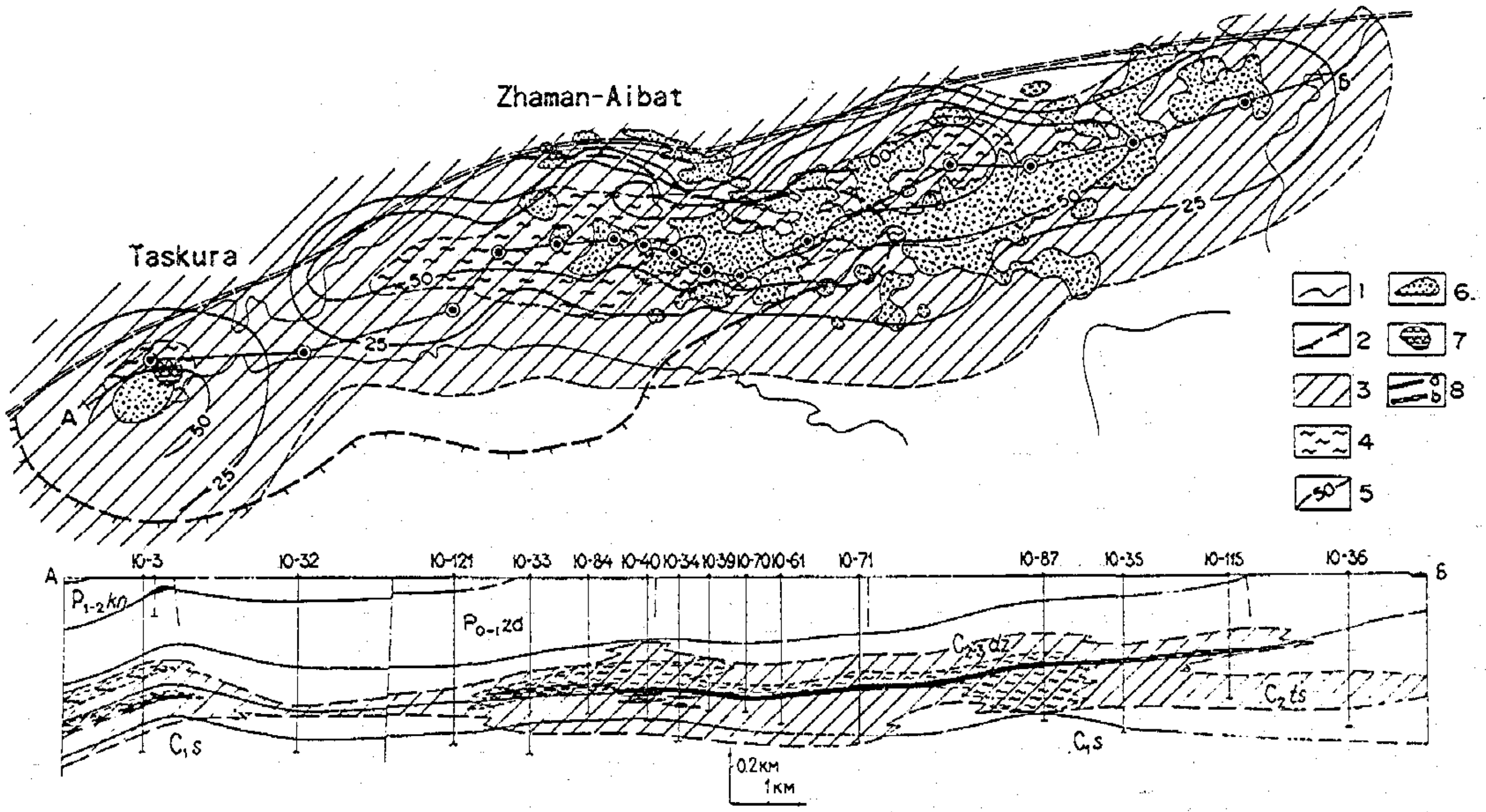


Figure 1-4-1 Geological Structure Map of the Zhaman-Aibat Area

(2) The stratiform copper mineralization occurs exclusively in the grey colored alluvial or deltaic sandstone faces within the "Red Sandstone Formation" that ranges in age from the middle to late Carboniferous and the early Permian (Figure I-4-2).
(3) 825 drillholes on a 200m×200m grid spacing confirm that there are three main orebodies, namely, the Central, Northern and Eastern Orebodies. These orebodies are distributed in an area with dimensions : 12.5km in the east-west direction and approximately 5 km in the north-south direction. The depth of the ore horizon is approximately 350m~500m in the eastern area and the depth increases towards the west. At the western edge of the Central Orebody it reaches 700m~750m in depth.
(4) Ore minerals are mainly composed of chalcocite, djurleite, digenite and bornite accompanied by small amounts of chalcopyrite, galena and sphalerite. Rare occurrences of tennantite, native silver, native copper, Ag rich electrum, gersdorffite-cobaltite series minerals and covellite are found. With the assemblage of these minerals, four ore types, namely copper ore (Cu), complex ore (Cu+Pb+Zn), lead-zinc ore (Pb+Zn) and silver ore (Ag+Cu) are classified.
(5) Mineral composition, texture and structural properties of rocks and ores at the deposit are similar to these of the Zhezkazgan copper deposit and the two are therefore generally analogous. In the Zhezkazgan copper deposit, 10 mineralized horizons are reported in the grey sandstone formation of Carboniferous age and 9 horizons are said to have been calculated as having minable ore reserves. On the other hand, in the Zhaman-Aibat copper deposit, 3 ore horizons (Horizon-2, 3 and 4) are commercially interesting. In particular, Horizon 4-I and a part of Horizon 3-VI are rich in copper, lead, zinc and silver with thick ore layers and represent the main part of the Zhaman-Aibat copper deposit.
(6) MJK-1 drilled in this year's campaign confirmed the details of mineralization of Horizon 4-I in the Eastern Orebody. The total length of the mineralized zone is 7.78m, ranging from 598.0m to 605.78m depth. Chalcocite was the predominant ore mineral, accompanied by a small amount of bornite and galena. Rare abundance of chalcopyrite, electrum, gersdorffite-cobaltite series minerals, were noticed. The ore type was copper and the ore mineral occurrences showed mainly impregnation and rarely veinlet and thin stratiform layers. Chemical assay results of the mineralization zone of 7.78m mentioned above showed that average grade contents were 3.78%Cu, 1.17%Pb, 0.03%Zn and 22.7 g/t Ag.

4-2 Ore Reserve Estimation

For the second straight year the ore reserves (i.e. geological resources estimation) for



Glybovski V. O. (1988)

1 Boundary of outcrop of cuprous red coloured formation
2 Epicentre of con-sedimentation
3 Distributed area of epigenetic grey coloured rocks
4 Distributed area of syngenetic grey coloured rocks
5 Isopac line of grey sandstone
6 General outline of assumed-commercial mineralization of the Zhezkazgan type
7 The outline of assumed-commercial mineralization of the Mansf eld type
8 Ore body (a: high grade, b: low grade)

Figure 1-4-2 Geologic Setting of the Zhaman-Aibat Ore Deposit the Eastern Orebody and main part of the Central Orebody were calculated by the Japanese survey team and were compared to the reserves estimated by the Zhezkazgangeologiya. The calculation was based on the data inputted to the Zhaman-Aibat copper deposit data base. The total number of the data entered into the data base was 3,851 from 402 drill holes and of these a total of 3,564 data entries from 302 drill holes were used for the calculation (Table 1-1-4).

As mentioned above, the Zhezkazgangeologiya classified ores into four types, namely copper ore , complex (Pb+Zn+Cu) ore, lead-zinc ore, silver ore.

Cut-off grades for each ore type were : 0.4%Cu for copper ore, 0.8% (Pb+Zn)+ 0.3%Cu for complex ore, 1.1% (Pb+Zn) for lead-zinc ore, 5g/tAg for silver ore.

From the results of evaluations of stratigraphy of mineralized horizons, mode of occurrence of ores, future mining and ore dressing operations, the Japanese survey team determined that there are two ore classifications, namely copper ore and complex (Pb+Zn+Cu) ore. Cut-off grades were determined to be as 0.4% Cu for copper ore and 0.8% (Pb+Zn) + 0.3% Cu for complex ore. Therefore the result of the Eastern Orebody reserve estimate calculated by the Japanese survey team is comparable to the result calculated by the Zhezkazgangeologiya. The result of the Central Orebody is however not comparable due to the different ore classification standard.

The calculation method of the Zhezkazgangeologiya was a conventional plan area method multiplying by the plan area(m^2) by the average thickness(m) and the average density of ore(2.600).

The Japanese survey team calculated ore reserves by a polygonal method. The plane boundary was delineated by the bisectors between ore penetrating drill holes and those that have not intersected the orebody.

By comparing the geological resources of the Eastern Orebody in Table 1-4-2, calculated by the Zhezkazgangeologiya and by the Japanese survey team, it can be seen that overall the results obtained by the Japanese survey team were larger in the ore reserve and lower in ore grade , due to the discrepancy of ore/waste definition and the incorporation of recent additional drill data.

The area of the Eastern Orebody calculated by the Japanese survey team is 8,747,002 m^2 (98.7% of 8,858,095 ㎡ by the Zhezkazgangeologiya) and the average thickness is 5.15 m (114.4% of 4.50m). Then, using the conventional value of density, 2.600 (same value used by the Zhezkazgangeologiya), the total ore reserve is calculated as 117,087,382tons (112.3% of 103,741,698tons). Thus, the copper metal amount is calculated as 1,596,560 tons (105.9% of 1,507,290tons), the average copper grade is 1.36%Cu (93.8% of 1.45% Cu) and the average silver grade is 10.78g/tAg (91.4% of 11.80g/tAg).

Table I-4-2 Geological (In-Situ) Resources of the Zhaman-Aibat Deposit

Eastern Orebody

		Area (sq.m)	Thickness (m)	Ore weight (t)	Cu (t)	Ag (t)
Japanese-Survey Team (1995,96)	Eastern Orebody excect BLOCK-A	5,381,676	4.96m	69,387,490	719,677 1.04%	823.75 11.87g/t
	BLOCK-A	3,365,326	5.45m	47,699,892	876,833 1.84%	438.55 9.19g/t
	Total	8,747,002	5.15m	117,087,382	1,596,560 1.36%	1,262.30 10.78g/t
Zhezkazgan-geologiya (1994)	Eastern Orebody excect BLOCK-A	5,410,699	4.07m	57,311,798	671,590 1.17%	812.18 14.17g/t
	BLOCK-A	3,447,426	5.18m	46,429,900	835,700 1.80%	411.80 8.87g/t
	Total	8,858,095	4.50m	103,741,698	1,507,290 1.45%	1,223.98 11.80g/t

Central Orebody

	Area (sq.m)	Thickness (m)	Ore weight (t)	Cu (t)	Pb (t)	Zn (t)	Ag (t)
Cu Ore	1,696,332	3.97	17,505,852	328,542 1.88%	53,523 0.31%	12,825 0.07%	184.97 10.57g/t
Complex Ore	1,172,863	5.77	17,599,690	271,169 1.54%	311,434 1.77%	57,289 0.33%	192.59 10.94g/t
Total	2,869,194	4.71	35,105,542	599,711 1.71%	369,957 1.04%	70,114 0.20%	377.56 10.75g/t

On the other hand, the results of the Central Orebody calculated by the Japanese survey team indicated a total ore reserve of 35,105,542tons with an average thickness of 4.71m and average grades of 1.71%Cu, 1.04%Pb, 0.20%Zn and 10.75g/tAg, respectively. Among these ore reserves, the complex ore is estimated to be 17,599,690 tons and the average thickness is 5.77m, with an average grade of 1.54%Cu, 1.77%Pb, 0.33%Zn, 10.94g/tAg, respectively.

4-3 Drilling Survey

For the purpose of obtaining representative samples of copper ore for geological and mineralogical studies and ore dressing tests, MJK-1 was drilled in the Eastern Orebody. Drilling was performed by adopting the ordinary wire-lined method with final core diameter ϕ 35 mm. The duration of drilling was from August 13, 1995 to August 25, 1995. The total core recovery was as high as 98.5% and drill hole inclination ranged from 0° 30' to 1° 15'.

The general geology of MJK-1 drill hole showed reddish-brown sandstone and siltstone from the surface to the depth of 415.5m. From 415.5m to 440m, alternations of reddish-brown and grey sandstone and siltstone were observed, and from 440m to 610.75m grey sandstone was present. Finally, from 610.75m to the bottom (650m), reddish-brown siltstone and sandstone were predominant.

The copper mineralization could be observed between the depths of 598.0m and 605.78m. The mineralized core length reached 7.78m with an average content of 3.78 % Cu, 1.17% Pb, 0.03%Zn and 22.7g/t Ag.

The mineralized cores were split and one half of the core was provided for laboratory tests and the works, such as chemical analysis, microscopic observation, electron-probe microanalysis. The other half of the core was used for ore dressing tests.

4-4 Surveys of Mining Technology and Mining Cost in the Zhezkazgan Copper Mine

The final goal of this project is to study and evaluate the Zhaman-Aibat copper deposit. In order to gather the essential data on the calculation of minable ore reserves and conceptual design of the mine development, scheduled for 1996, mining operation, mining technology and operating costs of the Zhezkazgan mine, which is clearly morphologically and genetically analogous to the Zhaman-Aibat deposit, were surveyed. Following are the results of the survey ;

(1) The Zhezkazgantsvetmet joint stock company is holding four mining companies, and is involved in operations from mining, ore-dressing, smelting to refining. The company has been recently established for the purpose of market economy system after the break up of a "combine" which was the biggest under the former USSR.

(2) At present, under the Zhezkazgantsvetmet, 31,000 people are working in 14 companies, such as mine, ore dressing, smelting, refining etc.

(3) In the summer of 1995, the Samsung Corporation obtained the management right of the Zhezkazgantsvetmet providing the working capital and guaranteeing surety obligations. Previous financial difficulties in production are being solved and the sales amount of the Zhezkazgantsvetmet is being slowly increased.

(4) The Zhezkazgan copper deposit is being mined by four mining joint stock companies, namely the East Mine, West Mine, North Mine and South Mine. Among these mines, three are being operated by the underground mining method. The North Mine is being operated by an open pit mining method.

(5) The output of the mine in 1995 was 16,840 thousand tons with grade of 0.96%Cu including 5,160 thousand tons with grade of 0.64%Cu by open pit mining and 11,680 thousand tons, which represents 69% of the total mine production with grade of 1.10%Cu by underground mining.

(6) The orebody of the Zhezkazgan copper deposit is being mined by three kinds of the underground mining method, namely panel and pillar, room and pillar, and slicing methods. These mining methods are based on the morphology and properties of the ore deposits, such as thickness(m), ore grade(%Cu), inclination (degree) and the character of the country rocks and ores. In case of ore being thinner than 18m and less than 2.5%Cu in grade, the panel and pillar mining method is introduced. This mining method is being operated without filling and produces 75% of total mine production in the Zhezkazgan copper mine. The room and pillar mining method is introduced in the mining of ore grade higher than 2.5%Cu. After initial mining by the room and pillar method, filling work will be performed and after leaving for six months, second stage mining starts and fills the rest.

(7) The mining recovery is quite sensitive to parameters, such as diameter of room pillars, width of rib pillars and depth from the surface. By using formulae developed by the Giprotsvetmet Institute in Moscow, if the thickness of ore is 6m, mining recovery is calculated as 87.3%, 86.3%, 84.4%, 83.3% with increasing depth of 200m, 300m, 400m and 500m respectively. The Zhaman-Aibat ore deposit locates at greater depth than the Zhezkazgan deposit, mining recovery of 6m of ore thickness is estimated to be as low as 75.3% and 73.7% at the depths of 600m and 700m respectively.

(8) The information and data obtained on the mining costs are not sufficient for a detailed study. The estimated underground mining cost for the period from January to July in 1995, is 413 Tenge/ton-ore or 6.7 $US/ton-ore (at 60 Tenge/$US). These costs include the exploration costs and transportation costs to the hopper of vertical shafts. On the other hand, the estimated open-pit mining cost is approximately 260 Tenge/ton-ore or 4.3 $US/ton-ore.

4-5 Ore Dressing Test

(1) The grade of the test sample for the ore dressing test was 1.69%Cu, 0.51%Pb, 0.03%Zn and 12g/tAg.

(2) The main constituent ore mineral was chalcocite with small amounts of bornire, galena, and pyrite. Minor amounts of chalcopyrite, spalerite and rutile were also present. The size of mineral particles was generally fine, 1～500 μ m.

(3) The estimated value of the work index was 15.4kWh/t. Generally speaking, this smple ore was rather hard.

(4) The optimized rougher flotation size was minus 200 mesh 65%, and the flotation time was 10 minutes.

(5) For differential flotation, the suitable reagents were sodium isopropyl xanthate as collector and potassium ferrocyanide as depressant.

(6) With greater re-grinding, the lead recovery increased but excessive re-grinding decresed the lead recovery.

(7) By the bulk differential flotation process, the copper concentrate of 39%Cu and 1%Pb with copper recovery 86% and the lead concentrate of 48%Cu and 11%Pb with lead recovery 67% were obtained.

(8) By the straight differential flotation process, the copper concentrate of 30%Cu and 3%Pb with copper recovery 85% and the lead concentrate of 59%Cu and 10% Pb with lead recovery 67% were obtained.

(9) Considering the lead concentrate, straight differencial flotation is better, but considering the copper concentrate, bulk differential fltation is better. So the bulk differential flotation process is economically superior.

Chapter 5 Conclusion and Recommendation

5-1 Conclusion

The result of the present study lead to the following conclusions.

(1) Zhaman-Aibat copper deposit represents resources that are essential to the economy of the Republic of Kazakhstan. It is recommended to proceed not only with the exploration of new ore deposits but also the evaluation of the known, unexploited deposits.

(2) By the results of previous data analysis, drilling surveys and various kinds of laboratory tests, it is proved that the Zhaman-Aibat copper deposit is a type of stratiform copper deposit and has many analogies of geology and mineralogy to the Zhezkazgan copper deposit.

(3) For the purpose of obtaining representative samples of copper ore for geological and mineralogical studies and ore dressing test, MJK-1 (depth : 650m, vertical) was drilled in the Eastern Orebody. Total core recovery was as high as 98.5% and drillhole inclination ranged from $0^{\circ}30'$ to $1^{\circ}15'$. Copper mineralization could be observed between the depths of 598.0m and 605.78m. The mineralized core length reached 7.78m with an average grade of 3.78%Cu, 1.17%Pb, 0.03%Zn and 22.7g/tAg. Chalcocite was the predominant ore mineral, accompanied by a small amount of bornite and galena. Rare abundance of chalcopyrite, electrum, stromeyerite, gersdorffite-cobalite series mineral, were noticed. The ore type was typical copper ore.

(4) The ore dressing test sample was taken from the boring cores of the deposit and some important deta for deposit evaluation were obtained by the ore dressing tests. The ore grade was 1.69%Cu, 0.51%Pb, 0.03%Zn and 12g/tAg. The main copper mineral was chalcocite and small amounts of galena were observed. The ore was rather hard with the work index 15.4KWH/t. The optimum flotation process is bulk differential flotation and the copper concentrate of 39%Cu and 1%Pb with copper recovery 86% and the lead concentrate of 48%Cu and 11%Pb with lead recovery 67% were obtained.

There are much other types of ore body such as "complex ore (Pb+Zn+Cu)", "copper-silver ore (Cu+Ag)" and so forth within this deposit. So, more ore dressing tests should be done for those other ore types.

(5) The investigation of the Zhezkazgan operating mine confirmed that mining technology being used in the mine is applicable to the exploitation of the Zhaman-Aibat copper deposit. It is concluded that the mining costs, or capital cost and a part of the operation cost should be investigated in 1996 for the economic evaluation.

(6) For the ore reserve evaluation scheduled in the Phase III, construction of the "Zhaman-Aibat data base" was started and approximately 75% of total data on drilling and on chemical assay were input to the data base. It is quite essential for ore reserve evaluation and future planning to construct it in an early stage.

(7) For the second straight year, the ore reserves (i.e. geological resource estimation) for the Eastern and main part of the Central Orebody were calculated by the polygon method using approximately 302 drillholes with 3,564 point data sets.

The results of the Eastern Orebody showed that the ore reserve as copper ore is calculated as 117 million tons with an average grade of 1.36%Cu and 10.78g/tAg, and an average thickness of 5.15m.

On the other hand, the results of the Central Orebody indicated that the total ore reserve is 35 million tons and the average grades are 1.71%Cu, 1.04%Pb, 0.20%Zn and 10.75g/tAg and the average thickness is 4.71m. The ore reserve for the complex ore is calculated as 17.6 million tons with an average grade of 1.54%Cu, 1.77%Pb, 0.33%Zn, 10.94g/tAg and an average thickness of 5.77m.

It can be seen that the overall results obtained by the Japanese survey team were larger in the ore reserve and lower in ore grade than those obtained by counterparts due to the discrepancy of ore/waste definition between the estimations.

(8) In the Phase I report, it was pointed out that all works from assay data sheet preparation to the ore reserve estimation were done by hand and produced several data sheet. Errors, omissions and inconsistencies in the hand written data sheets reduce the reliability of each data. It is therefore recommended to adopt a computer system for the management of exploration data.

In response to this recommendation, the Government of Japan donated a set of personal computer systems including computers and printers to the Zhezkazgangeologiya. The system is being adopted for the geophysical data analysis and processed the previous survey data.

There are, however, some problems related to lack of personal computer sets, software and lack of skill staff in computer operation. Introducing the computer system into the daily exploration works is urgently required.

5-2 Recommendation for Phase III Survey

Based on this year's results, it is recommended to carry out the following exploration works for the Phase III (1996) campaign.

(1) Study and evaluate previous survey data, in particular, data evaluation the Central and Northern Orebodies, and three Orebodies are needed.

(2) Drilling survey

It is recommended to drill in order to obtain basic data and ore samples for ore dressing test in the Central Orebody for complex ore and in the Northern Orebody for copper-silver ore.

(3) Ore dressing test

By using the mineralized core samples of complex ore and copper-silver ore, ore dressing tests should be carried out in order to confirm the basic parameters of ore reserve evaluation.

(4) Ore reserve evaluation

① study of the present drilling interval by the geostatistical approach.

② investigation of the capital and operating costs

③ minable ore reserve calculation

④ conceptual design and economic evaluation of the Zhaman-Aibat Mine

PART II

DETAILED REPORT

PART II. DETAILED REPORT

Chapter 1 Analysis of Previous Survey Data

The Zhaman-Aibat area is located in the southwestern part of Central Kazakhstan, approximately 180 km southeast of Zhezkazgan. The geographic coordinates of the four corners of the Zhaman-Aibat survey area are (in clockwise direction): point 1 : 46° 40'10"N／68° 41'30"E, point 2 : 46° 55'30"N／68° 34'00"E, point 3 : 47° 06'00"N／69° 18'40"E, point 4 : 46° 50'40"N／69° 26'00"E (Figure 1-1-1).

The area is accessible by driving 90km from Zhezkazgan on an all-weather road (the Kzyl-Orda road) to a crossing of the Sarysu River and then driving eastward for 90km on a gravel road to reach Zhaman-Aibat Area.

The survey area is situated on the eastern flank of the Zhezkazgan-Sarysu depression formed during the Carboniferous age. The area may physiographically be divided into two units reflecting underlying geology. The first unit has relatively moderate relief, low hills with relative heights 10～30m and absolute heights ranging from 300 to 320m altitude. The second unit is of high relief in the center of the area, where the Zhaman-Aibat horst anticline formed. The relative height difference between the two units is approximately 60～80m. The drainage in the area is partly integrated due to the dry continental climatic condition.

1-1 Previous Surveys

1-1-1 Geological Survey

Systematic geological works started in the 1920's. The first geological map of the Zhezkazgan-Ulsan area was made, and the Taskura deposit, located 5km west of the Zhaman-Aibat deposit, was discovered at this time.

Kanysh I. Satpayev paid special attention to issues of metallogeny and stratigraphy of the Zhezkazgan Area. These works resulted in commercial estimation of the Zhezkazgan area in the 1930's and this area was recognized as one of the most important mining areas in Kazakhstan. In the 1940's several important exploration works were done by regular geological mapping methods. In 1953, the Taskura deposit was explored by drilling which confirmed mineralization rich in copper located close to the surface. Since 1959, the Zhezkazgan Expedition Party has carried out exploration drillings for copper deposits in the territory of the Zhezkazgan-Sarysu depression. During 1959～1964, exploration parties drilled in the Zhaman-Aibat area and confirmed copper mineralization at the depth of 400～700m beneath the surface. Its thickness was estimated as 0.4～1.0m with copper grade of 1.16～1.30%.

Essential exploration for copper was carried out during 1981～1984 by the Zhezkazgan Exploration Expedition Party on the eastern flank of the Zhezkazgan-Sarysu depression and resulted in the detection of commercial grade copper and copper-lead mineralization at the depth of 615m～700m.

Drilling statistics from 1981 to October 1995 are summarized in Table 2-1-1 and the previous geological works are shown in Plate III-1-2-1 of Phase I report. According to the drilling statistics, since 1981, a total of 996 holes have been drilled with a total drilling length of 632,467.4m. Of the 996 holes, a total of 825 were for exploration purposes and 171 holes were drilled with large diameter and short length for sampling. These drillholes are divided into five groups on the basis of exploration stages and correlate to the following ore reserve categories: drilling for overall prospecting is correlated to P_1 and P_2 categories; drilling for detailed prospecting, preliminary estimation and preliminary survey are correlated to C_2, C_1, A and/or B categories, respectively. Beside these, drillholes for prospecting are considered to be a kind of scout drilling in the ordinary exploration strategy.

Of the 825 holes drilled for exploration purposes, 423 have penetrated the main ore horizon 4-I and 149 holes confirmed the other mineralized horizons. Thus the total number of drillholes which penetrated mineralized horizons amount to 572 holes.

Final core diameter of each exploration drillhole is 59㎜ and all mineralized cores have been used for various kinds of chemical assay and metallurgical testing. Only small pieces of mineralized core of each drill hole have been retained as preserved samples.

1-1-2 Geochemical Surveys

Previous geochemical studies of the Zhaman-Aibat area are given in Table 2-1-2. Geochemistry of the area has been systematically studied by Zhezkazgan geological expedition since 1981.

The geochemical surveys (1981 to 1984, and 1987 to 1990) have resulted in delineating mono-element and complex haloes of chemical elements, forming four large halo areas, namely : Taskura, Zhaman-Aibat, Azat and Zhatyka.

The Taskura area (Cu is up to 0.8%, Ag is up to 0.004%, Pb is up to 0.025%, Ba is up to 8%) in its southeastern part exactly coincides with the Taskura copper deposit,

Table 2-1-1 Drilling Statistics in the Zhaman-Aibat Area

(TD):Technical Drilling

Year	Total Prospecting,P1,P2			Detailed Prospeting,C2			Prospecting Estimation,C1			Preliminary A & B (include.Cl)			Prospecting			Total		
	Nos of drill	(TD)	Total Length (m)	Nos of drill	(TD)	Total Length (m)	Nos of drill	(TD)	Total Length (m)	Nos of drill	(TD)	Total Length (m)	Nos of drill	(TD)	Total Length (m)	Nos of drill	(TD)	Total Length (m)
1981	2		1,760.0													2	0	1,760.0
1982	14		11,743.6													14	0	11,743.6
1983	19		16,110.1													19	0	16,110.1
1984				25		20,656.9										25	0	20,656.9
1985				37		30,869.7										37	0	30,869.7
1986				26		20,297.3										26	0	20,297.3
1987				2		1,667.2	26	7	21,184.9							28	7	22,852.1
1988							57		38,543.6	85	50	62,611.2				142	50	101,154.8
1989										160	81	119,231.1	3		2,465.8	163	81	121,696.9
1990										95	25	73,999.1	16		13,634.6	111	25	87,653.7
1991										94	8	68,141.3	9		8,744.5	103	8	76,885.8
1992										56		42,778.8	7		6382.8	63	0	49,161.6
1993										49		37,905.6				49	0	37,905.6
1994										24		18,838.3	2		1,880.0	26	0	20,718.3
1995										17		13,021.0				17		13,021.0
Subtotal	35	0	m	90	0	m	83	7	m	580	164	m	37	0	m	825	171	m
Total	35		29,613.7	90		73,491.1	90		59,728.5	744		436,526.4	37		33,107.7	996		632,467.4

localized in the sediments of the Kengir Formation. Its northwestern part is probably shaped as a scattering flow. The Zhaman-Aibat area (Cu is up to 0.03%, Ag is up to 0.00015%, Ba is up to 0.2%, Pb is up to 0.005%) is associated with deeply occurring mineralization (it is possible that haloes were injected from underneath along the zone of sub-latitudinal faults, supposed to be located here.) The Azal and the Zhatyka halo areas are confined to the central part of the Azat anticline and the Zhatyka halo area, respectively.

Table 2-1-2 List of Previous Geochemical Survey in the Zhaman-Aibat Area

Index	Organization	Survey year	Scale Network (m)
1	AGPhE, Stroiteleva A.	1954	1:200,000
2	DGPhE, Skalskii N.	1959	1:50,000
3	DGPhE, Skalskii N.	1960	1:50,000 500x50
4	DGPhE, Stefankevich Z.	1961	1:50,000 500x50
5	DGRE, Schuvatov T	1981-1984	1:50,000 500x50
6	DGRE, Scheripov A.	1987-1990	1:50,000 500x100

DGPhE-Zhezkazgan Geophysical Exploration Expedition
DGRE -Zhezkazgan Geological Exploration Expedition
AGPhE-Atasu Geophysical Experdition

1-1-3 Geophysical Surveys

The previous geophysical surveys of the Zhaman-Aibat area are given in Tables 2-1-3, 2-1-4, 2-1-5 and 2-1-6.

Geophysical studies of the area have been carried out since the 1950's. Areal magnetic surveys were completed in 1955 to 1996 at the scale of 1:50,000 and 1:100,000 (Table 2-1-3). They have resulted in a general understanding of the magnetic field in the area, and have assisted in evaluating prospects of finding iron ore related to ultrabasic bodies along deep seated faults.

The first ground survey was carried out by the Atasu Expedition (1954) in a small region ($6km^2$), located in the western part of the area. The survey utilized electric methods (Electrical profiling, VES, etc.) and was targeted at prospecting for underground water. However, no positive results were obtained. A 1:200,000 scale

Table 2-1-3 List of Previous Magnatic Survey in the Zhaman-Aibat Area

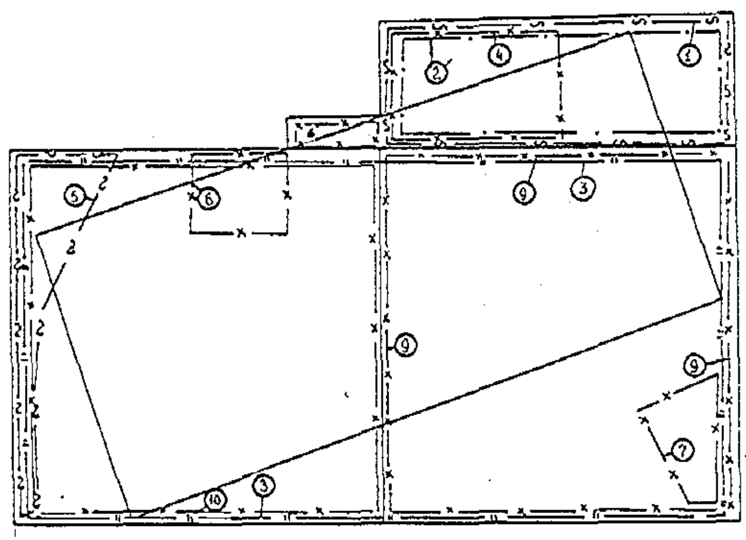
No.	Organization	year	System	Scale Network(m)	Accuracy nT
1	ZGT. Kukin G.	1952	Aeromagnitic Survey AEM-49	1:100.000	+/- 29
2	AGPhE. Stroiteleva L.	1954	Aeromagnetic Survey M-2	1:200.000 1000x200 2000x4000	+/- 10-15
3	ZGT. Zavjalova L.	1955	Aeromagnetic Survey AEM-49	1:500.000	+/- 30
4	DgPhE. Stefankovich Z.	1961	Aeromagnetic Survey M-2	1:50.000 500x100	+/- 9.7
5	KGT. Sargaskaev T	1960	Aeromagnetic S. ASGM-25. ASG-45	1:100.000	+/- 25
6	DGPhE. Skalskii N	1960	Ground survey M-2	1:50.000 500x50	+/- 11-14
7	DGRE. Kogai S.	1976-78	Ground survey MMS-1	1:50.000 500x10	+/- 11-14
9	DGRE. Shuvatov T.	1984	Ground survey MMA-301	1:50.000 500x50	+/- 6
10	DGRE. Scheripov A	1987-90	Ground survey MMP-203	1:50.000 500x100	+/- 3

ZGT - Western Geophysical Trust, KGT - Kazakh Geophysical Trust
DGPhE- ZHEZKAZGAN Geophysical Exploration Expedition
DGRE - ZHEZKAZGAN Geological Exploration Expedition

Table 2-1-4 List of Previous Gravity Survey in the Zhaman-Aibat Area

No	Organization	Survey year	Grivimeter	Scale Network(km)	Accuracy (mgal)
3	DGPhE. Loskutov A.	1957	SN-3	1:200.000 4x1	+/- 0.50
4	DGPhE. Skalskii N.	1959	GAK-3M GAK-4M	1:50.000 0.5x0.5	+/- 0.21
5	DGPhE. Skalskii N.	1960	GAK-3M GAK-4M	1:50.000 0.5x0.5	+/- 0.17
6	DGPhE. Stefankevich Z.	1961	GAK-3M	1:50.000 0.5x0.25	+/- 0.10
8	DGPhE. Antonov V.	1967	GAK-PT	1:200.000 3x2	+/- 0.32
9	DGRE. Kogan E.	1973-1974	GAK-PT GR/K-2	1:50.000 1x0.5	+/- 0.16
10	DGRE. Schuvatov T.	1981-1984	GR/K-2	1:50.000 0.5x0.5	+/- 0.12
11	DGRE. Scheripov A.	1987-1990	GNU-KV GNU-KS	1:50.000 0.5x0.5	+/- 0.09

DGPhE- ZHEZKAZGAN Geophysical Exploration Expedition
DGRE - ZHEZKAZGAN Geological Exploration Expedition



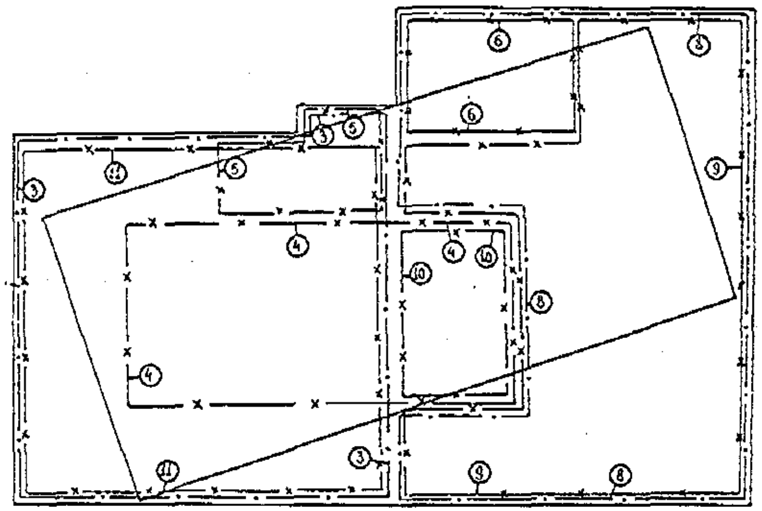


Table 2-1-5 List of Previous Electric Survey in the Zhaman-Aibat Area

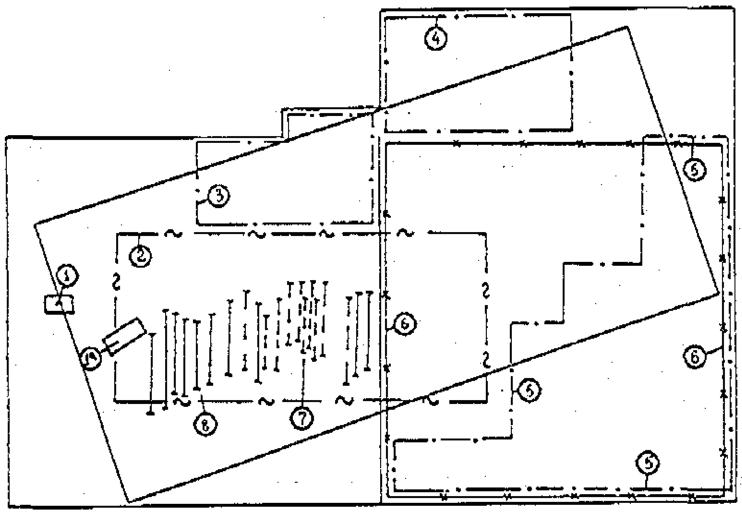
Index No.	Organization	Year	Equipment	Scale Network (km)	Accuracy (%)
1 1.a	AGPhE. Stroiteleva A	1954	EP-1	1:100,000 SP, Moving Schlum0.1x0.02 VES, IP	3-5
2	DGPhE. Skalskii N.	1959	EP-1	1:100,000 VES 2x1, 1x1, AB=1-4	max 5
3	DGPhE. Skalskii N.	1960	EP-1	1:200,000 VES, 4x3, 2x1, AB=max 12	max 5
4	DGPhE. Stefankevich Z.	1961	ESK-1	1:200,000 VES, 4x3	max 4.6
5	DGPhE. Antonov V.	1967	ESK-1	1:200,000 VES, space=2, AB=1-1.5	max 5
6	DGRE. Schuvatov T.	1984	AE-72 VPS-63	1:50,000 VES, 1x1, 1x0.5, AB=max 1 Gradient IP, a=0.05, AB=1.6	3.2
7	DGRE, Smirnova N	1986	CYCLE-2	1:50,000 TEM, line=1-2	< 5
8	DGRE, Scheripov	1988	CYCLE-2	1:50,000 TEM, space=0.5	< 5

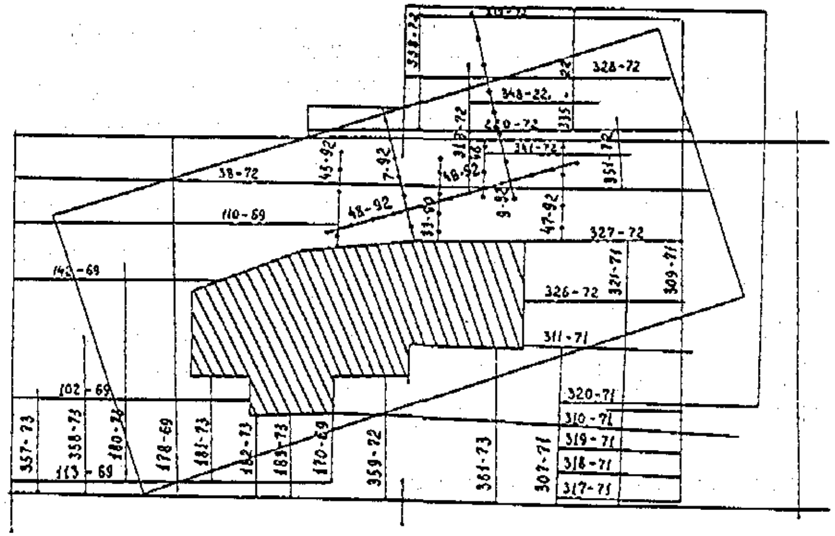
ZGT - Western Geophysical Trust, AGPhE- Atasu Geophysical experdition
DGPhE- ZHEZKAZGAN Geophysical Exploration Expedition
DGRE - ZHEZKAZGAN Geological Exploration Expedition

Table 2-1-6 List of Previous Seismic Survey in the Zhaman-Aibat Area

No.	Organization	year	Instruments
1		1964-1974	MOV (The reflection method)
2		1990-1992	MOGT (Common Depth Point)

DGPhE- ZHEZKAZGAN geophysical exploration expedition
DGRE - ZHEZKAZGAN geological exploration expedition





gravity survey was carried out by Zhezkazgan Geophysical Exploration Expedition in 1957 (Table 2-1-4, Report 3). It spotted a large positive anomaly in the Zhaman-Aibat area. These were however no geological interpretations given at that time. A 1:200,000 scale gravity survey was made in the eastern part of the area in 1967 (Table 2-1-4 ,Report 9), in combination with VES electric surveys in order to account for the influence of loose formations (Table 2-1-5, Report 5).

Geophysical surveys at 1:50,000 scale were carried out by the Zhezkazgan Geophysical Exploration Expedition in 1959 to 1960 within the Zhaman-Aibat area. These surveys included gravity (Table 2-1-4, Report 4), magnetic (Table 2-1-3, Report 6), electric survey of VES method (Table 2-1-5, Report 2 and 3) and geochemical surveys. This work resulted in delineating the Zhaman-Aibat anticlinal structure (based on gravity and magnetic survey), and was handed over to the Zhezkazgan Geological Exploration Expedition for further proving of Zhezkazgan type copper mineralization by drilling. Test drilling was carried out in 1962 to 1964. Drilling however did not fully penetrate the structure (4-drillholes, 1925m). That work resulted in determining mineralization within 0.4～1m intervals, by the drillholes at the depth of 400～700m in grey sandstone within the productive rock mass, with the content of copper in the studied area. Between 1964 and 1974, the Zhezkazgan depression was systematically studied by seismic survey MOV (Seismic reflection), in order to study the structure of the Upper Paleozoic rock masses and to delineate prospective oil and gas structures. The southeastern flank of the depression has been studied by a network of lines, with the spacing of 4 to 8km and at some spots using a spacing of 2km or less. At the same time, in order to assist the interpretation of the seismic survey results in the form of maps of isodepth of reflecting horizons have shown an increase in thickness of the Carboniferous sediment in the eastern part of the Zhezkazgan-Sarysu depression close to the flanks (Taskura-Tasbulack trough). A number of anticlinal structures have been delineated which are prospective for oil and gas. Seismic surveys also allowed more detailed delineation of the Zhaman-Aibat anticline structure and the depth of the bottom of productive sediments for copper has also been estimated.

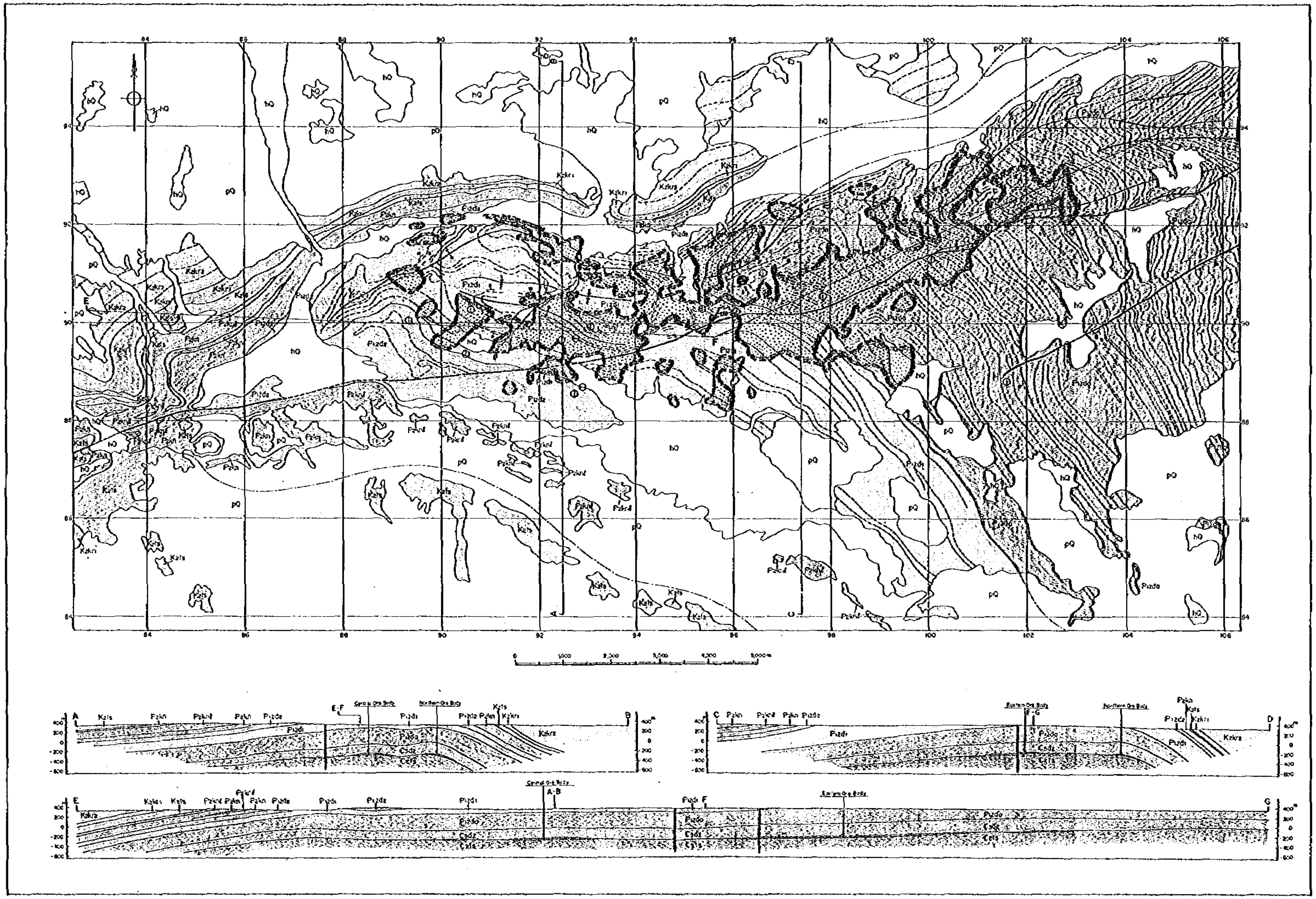
Based on analysis of both geophysical and geological data collected by the Zhezkazgan Geological Exploration Expedition in 1980, a program of study and prospecting for copper in the Zhezkazgan-Sarysu depression was formulated. The Zhaman-Aibat anticline structure was included as a first priority structure. It was first found in 1959 by a geophysical survey, and later confirmed by geological studies. In compliance with that program, 1:50,000 scale geophysical surveys were carried out in the area of the Zhaman-Aibat structure from 1981 to 1984 and from 1987 to 1990. Surveys included gravity (Table 2-1-4, Report 10 and 11), magnetic (Table 2-1-3, Report 9 and 10), electric of VES, IP and ZSB (TEM) methods (Table 2-1-5, Report 6 and 8), geochemical and shallow scout drilling. From 1983 to 1986, and 1990 to 1992 detailed seismic MOGT (CDP) survey (Table 2-1-6, Report 2) were conducted in combination with electric surveys of ZSB (TEM) (Table 2-1-5, Report 7) with spacing of 0.8 to 2 km. Results of these surveys, made it possible to compile uniform maps of geophysical and geochemical fields covering the entire described area at the scales of 1:50,000 (sprit in pages) and 1:100,000 (plan view) and to obtain valuable information on the deep structure of the territory, the structural position of the Zhaman-Aibat deposit and possible directions of further prospecting and exploration works.

Based on both analysis of geological maps, the locations of discovered ore deposits in the Zhaman-Aibat field and separate ore boreholes to the west, it has been concluded that ore bodies and mineralization zones are located mostly on the flanks of local anticline structures and somehow "frame" them. This finding has made it possible to locate probable positions of ore zones not yet penetrated by drilling within Zhaman-Aibat and Azat structures and to place prospecting and exploration drillholes accordingly.

The Zhaman-Aibat anticline structure is shown as a structural nose in the 1:200,000 scale geological map (Plate I-3-2-1 in Phase I Report). A number of local positive gravity anomalies with 1 to 2 mgals amplitude as well as uplifts of the R2, R2', R3 horizon depth contours, outlining positions of subsidiary anticlines (Azat, Zhaman-Aibat) have been delineated within the huge structure.

1-2 Geology

The Zhaman-Aibat area is positioned on the eastern flank of the Zhezkazgan-Sarysu depression, close to the junction with the Chu-Ili anticlinorium at the Bekei deep-seated fault. The geologic formations of the area range in age from the Carboniferous to the Quaternary including mainly sedimentary rocks (Figure 2-1-1). The stratiform copper mineralization occurs exclusively in the grey-colored alluvial-deltaic sandstone faces within "Red Sandstone Formation" of the Carboniferous (Figure 2-1-2). The tectonic structure of the ore deposit area is related to the axial zone of the Zhaman-Aibat horst anticline, stretching in sub-latitudinal direction with steep northern (30～45°) and gentle southern (up to 5～10°) limbs. The absence of igneous and intrusive activities and significant thickness of sediments are characteristics of the geology in the area (Figure 2-1-3).



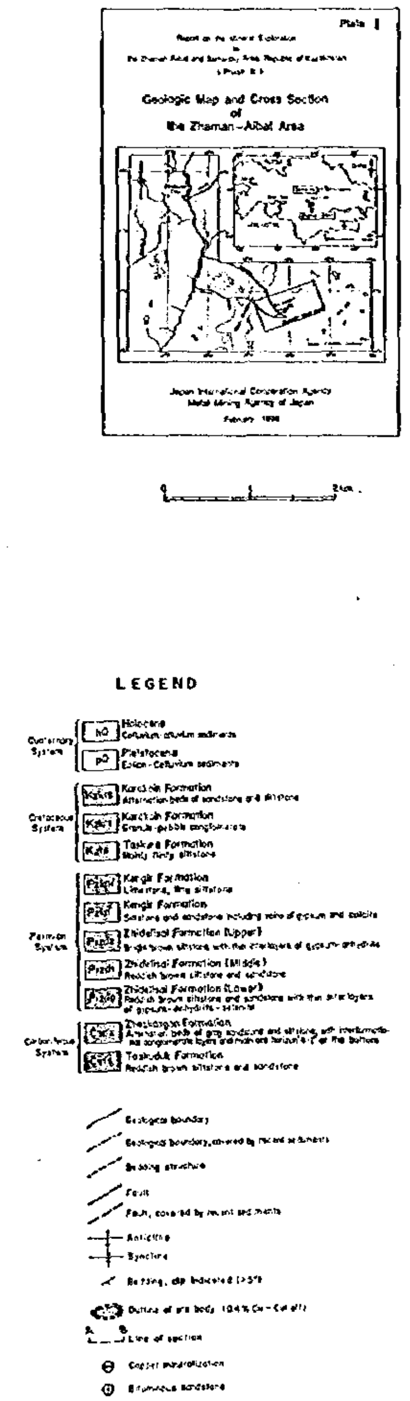
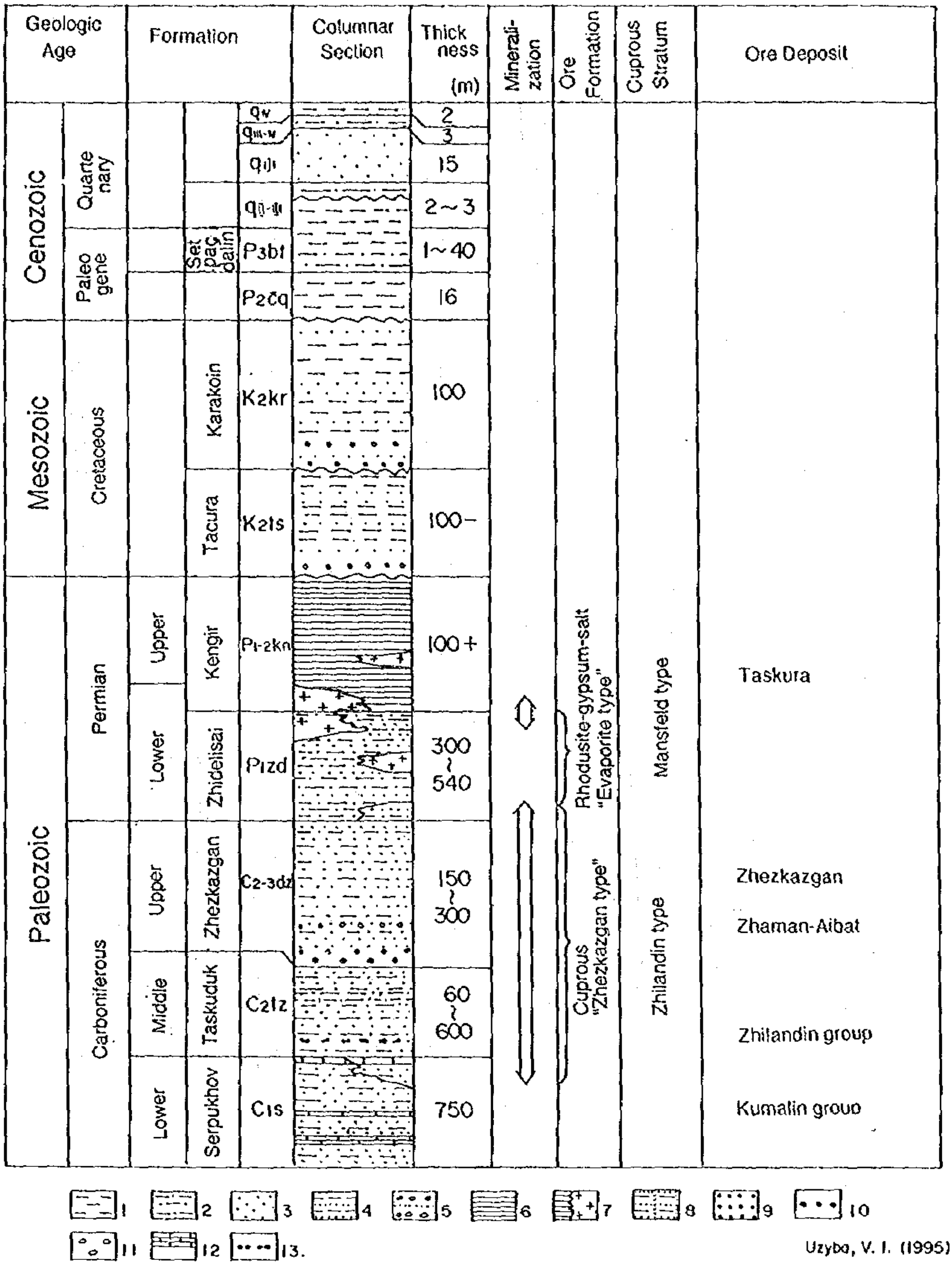
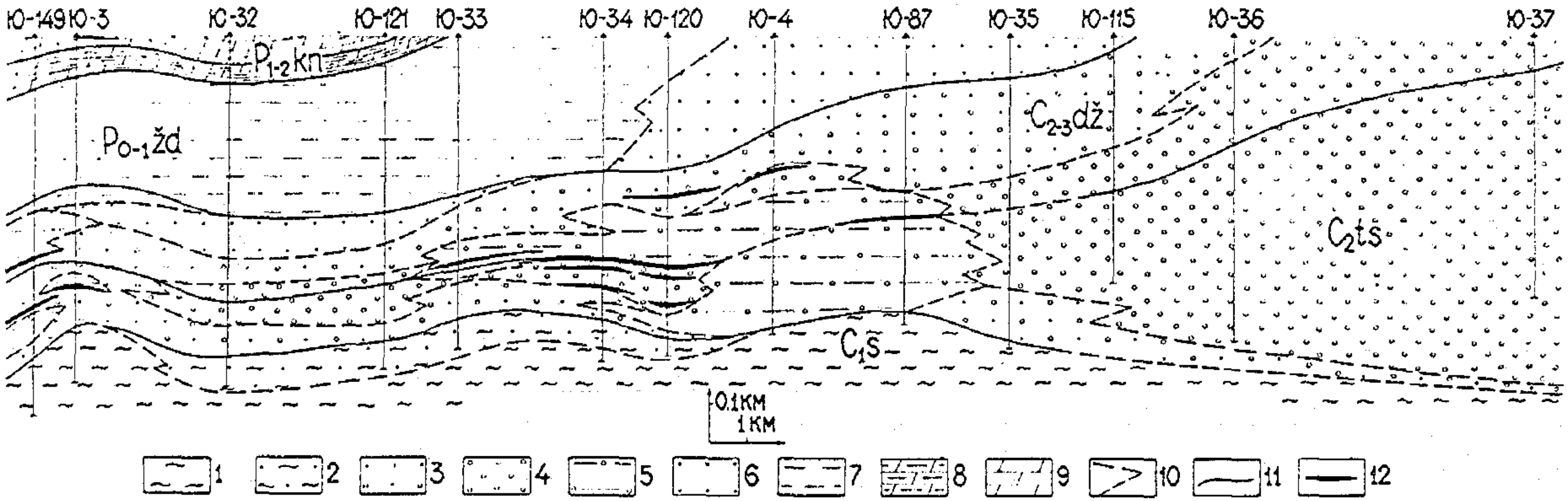


Figure 2-1-1 Geological Map and Cross-Section of the Zhaman-Aibat Area



1 Alluvial and lacustrine clays 2 Diluvial-proluvial sandy loam
3 Eolian sand 4 Speckled clay 5 Gravel-pebbles 6 Marl
7 Salt 8 Aleurolite, argillite 9 Sandstone
10 Interformational conglomerate 11 Conglomerate
12 Limestone 13 Flint

Figure 2-1-2 Generalized Stratigraphic Column of the Zhaman-Aibat Area



1 Submarine facies zone
2 Subcontinental facies zone; Continental facies zone of lacustrine-alluvial plain:
3 Lacustrine-alluvial subzone
4 *Alluvial subzone*
5 Subaqueous lithofacies, continental facies zone of shallow lake and weak river streams
6 Alluvial-lacustrine subzone
7 Shallow water lacustrine subzone
8 *"Transition" facies zone*
9 Facies zone of lagoon-sea
10 Boundary of facies zone and subzone
11 Boundary of formation
12 Ore body

Glybovski V. O. (1988)

Figure 2-1-3 Idealized Geological Cross-Section of the Zhaman-Aibat Ore Deposit

1-2-1 Stratigraphy

1) Paleozoic group (Pz)

(1) Carboniferous system (C)

Sediments of the Carboniferous system are widely distributed within the survey area. Carbonaceous terrigenous complex of marine sediment is included in the lower series and a complex of various accumulations of continental origin in the middle and upper series (Figure 2-1-2).

Serpukhov Stage (C_1s)

Limestone, red sandstone and red aleurolite with interlayers of grey, green-grey and dark grey sandstone and aleurolite dominate in the upper part of the rock mass. The number of terrigenous rocks decreases at lower levels where there are interlayers of limestone in horizons of calcareous aleurolite. Total thickness is approximately 750m.

Taskuduk Formation (C_2ts)

Sediments of the Taskuduk Formation are deposited conformably on sediments of the Serpukhov Formation and are overlaid (with washout) by the sediments of the Zhezkazgan Formation. They are outcropping at the anticlinal structure in the eastern part of the area.

The upper boundary with the Zhezkazgan Formation follows the horizon of interformational conglomerate ("Raimundo "conglomerate) at the bottom boundary, and has a roof of limestone with fauna (Figure 2-1-2). Sediments of the Taskuduk Formation are represented by interbedded terrigenous rocks, formed under the conditions of coastal and alluvial plain. They are constituted by reddish and greyish fine-grained sandstone and aleurolite. Interlayers of conglomerate with partly rounded gravels of red rock and carbonate rocks are included. Sediments of the formation have not been age-determined paleontologically. The thickness of the formation varies from 60～70m at the axial part of the western part of the horst anticline, to 600m or more at the eastern, northern and southern wings.

Zhezkazgan Formation ($C_{2-3}dz$)

The rocks of the Zhezkazgan Formation are not exposed at the surface in the survey area, but are well distributed in the eastern flank of the depression at the core of the anticlinal structure, 5 km from the survey area.

Sediments of the Zhezkazgan Formation are deposited unconformably on the Taskuduk Formation with the interformational conglomerate ("Raimundo" conglomerate) at the bottom, and are conformably overlaid by the sediments of the Zhidelisai Formation.

In the area of the deposit these sediments are penetrated by drillholes to the depth of 400～500m. The upper boundary with the Zhidelisai Formation is conventionally delineated along the roof of grey fine-grained sandstone.

Sediments of the Formation are represented by red laminated sandstone, aleurolite and grey sandstone, rarely aleurolite with interformational conglomerate with interlayers of sedimentary breccia and interformational conglomerate ("Raimundo"), mentioned above.

The increase of the thickness of grey sandstone at the bottom of the Formation is typical of cross sections of the Zhaman-Aibat deposit, in which commercial grades of copper, lead and zinc were detected as a result of prospecting (Figure 2-1-4).

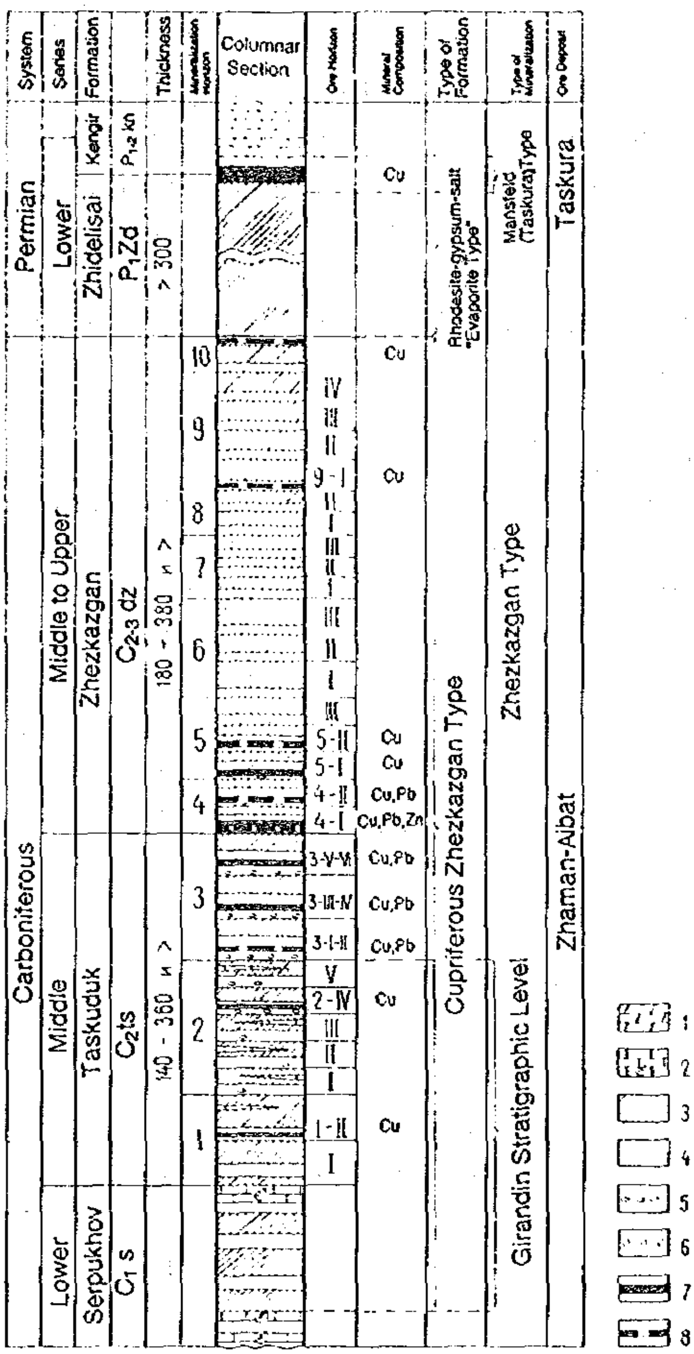
Sediments of both the Zhezkazgan and the Taskuduk Formation are represented by rhythmical interbedding of terrigenous rocks formed under the condition of alluvial plain. There are lithological types of rocks of river bed represented by residual gravel and sandy river crust, resulting from intensive freshet at the bottom of sediments of the Formation. Such sediment in the survey area of the Zhaman-Aibat deposit is typical only fast rhythmical sedimentation. Their total thickness is equal to dozens of meters. The upper rhythmical sedimentation, according to their internal structure, variation of thickness of composition similar to sediments of the Taskuduk Formation. The thickness of the Formation in the deposit area is 180～200m, and on the flanks it is estimated to be 300m and more.

(2) Permian system (P)

Sediments of the Zhidelisai and the Kengir Formations with terrigenous and terrigenous carbonate compositions, respectively, are defined within the Permian system (Figure 2-1-3).

<u>Zhidelisai Formation (P_1zd)</u>

The sediments of the Zhidelisai Formation are widely distributed in the area and form the core and wings of the anticlinal structure on the surface, and are penetrated by a number of prospecting drillholes. The Formation is conformably covered by the Kengir Formation. The sediments of the Formation are everywhere represented by obliquely laminated red aleurolite and sandstone with interlayers of brown (grey-red) fine grained



Glybovski V. O. (1988)

1 - Marl ; 2 - Limestone ; 3 - Red Aleuro-Argillite ; 4 - Grey Sandstone ; 5 - Intra Formation Conglomerate ; 6 - "Raimundo" Conglomerate and Gravelite ; 7 - Assumed Commercial Grade Mineralization ; 8 - Assumed Low Grade Mineralization.

Figure 2-1-4 Generalized Stratigraphic Column of Cupriferous Sediments of the Zhaman-Aibat Ore Deposit Area sandstone. The presence of gypsum and anhydrite is typical for the entire cross section and rock salt at the flanks of the structure, i.e., at the southern and western parts. The presence of rock salt, anhydrite and gypsum among red rocks of the Zhidelisai Formation make it possible to include in the evaporite complex of rocks formed under the conditions of hot climate at flood plain and lake faces. The thickness of sediments on the western flank is approximately 300m. On the northern flank it is estimated to be 540m and more.

Kengir Formation ($P_{1-2}kn$)

Sediments of the Kengir Formation are out-cropping only in the western part of the anticlinal structure and are penetrated by a number of drillholes.

They are deposited conformably on the Zhidelisai Formation and are unconformably overlaid by the Mesozoic-Cenozoic sediments. The Formation is represented by grey and dark grey marls, oolitic horizontal-layed limestone, limy aleurolite and sandstone.

Large amounts of gypsum in the lower part of the cross section of the Formation is typical. The copper deposit in the Taskura is represented both by oxidized and sulphide ores and occurs locally in the sediment of the Kengir Formation (Figure 2-1-4).

2) Mesozoic Group (Mz)

(1) Cretaceous system (K)

Taskura Formation (K_2ts)

Sediments of the Upper Cretaceous are deposited at sharp unconformity angles on the washed out surfaces of more ancient formations and are overlapped by the Cenozoic sediment of various ages (Plate Ⅲ-1-3-1 of the Phase I report). They are represented by alternations of grey and green opoka-like aleurolite, clays, inequigranular sandstone, conglomerate and marl.

The thickness of sediment does not exceed 100m.

Karakoin Formation (K_2kr)

Sediments of the Karakoin Formation are deposited unconformably on those of the Taskura Formation and are unconformably overlain by the Cenozoic sediment (Plate Ⅲ-1-3-1 of Phase I report).

Pebble to granule size conglomerates are observed at the bottom and alternations of eolian and speckled clay correspond to the middle and the upper.

3) Cenozoic Group (Kz).

(1) Paleogene system (P)

The Paleocence-Eocence sediments (P_{1-2}) overlie the Paleozoic and the Mesozoic formations of different ages and are represented by lenticular interbedded clay of various colors, aleurolite, sandstone with separate lenses of quartz-like sandstone. The thickness of sediment is 20～30m and reaches 120m in depressions.

Betpakdalin Formation (P_3bt)

Sediments of the Betpakdalin Formation of the Oligon age are widely distributed in the survey area and are represented by red, red-brown, brown and green clay with gypsum and manganese oxide with interlayers of aleurolite of brown color and clayey sand. The thickness of the sediment is 1～40m.

(2) Quaternary system (Q)

Quaternary system is represented by formation of various genetic types.
The composition;
① Middle-Upper-Quaternary (Q II-III) eolian sand and aleurolite with admixtures of gravel;
② Upper-Quaternary-Contemporary (Q III-IV) proluvium-deluvium loam, clayey sand, gravel;
③ Contemporary (Q IV) "takyr"-salsifies clay, aleuroite.
Total thickness does not exceed 10m.

1-2-2 Tectonic Structure and Magmatism

The survey area is located at the zone of intersection of the Chu-Ili anticlinorium with the eastern edge of the Zhezkazgan Sarysu depression. The Chu-Ili anticlinorium is represented by a linearly-stretched, folded structure, subsiding to the southwest under the cover of the sedimentary rocks, which form the Zhezkazgan - Sarysu depression, the border between these two structures follows the Bekei deep-seated fault (Figure 1-4-1).

From consideration of the character of the folding structure and lithology of the formations, four stages are defined:

(1) Early Paleozoic geosynclinal stage

This structural stage is represented by sediment of Vendian-Cambrian and the middle to upper Ordovician, which are folded into narrow linear folds in the northwestern direction. Folds are compiled by ruptured dislocation of faults. Sediments of this stage with sharp unconformity are overlain by orogenic formations.

(2) Devonian orogenic stage

This orogenic stage includes the volcanic rock mass of the lower to middle Devonian. The rock mass is composed of rather large and is overlain by anticlinal structures.

(3) Carboniferous - Permian subplatform stage

This orogenic stage is formed by terrigenous carbonate rocks of the upper Paleozoic. These sediments are most widely spread and they participate in the formation of the Zhezkazgan-Sarysu depression. Sub-lateral anticlinal structures are developed on the eastern flank of the Taskura-Tasbulak trough, which have the shape of a nose structure similar to the Zhaman-Aibat anticline. The absence of intrusive activity and significant thickness of sediments are typical for this structural stage.

(4) Mesozoic-Cenozoic stage

This structure is formed by gently pitching, mainly ferrigenous rocks of marine and continental origin, classified as Jurassic, Cretaceous, Paleogene and Quaternary period with a Mesozoic crust of erosion at the bottom. Sediments of Mesozoic-Cenozoic are referred to typically as platform sediments.

The structure of the area is determined by faults of northwestern and sub-longitudinal stailce. The former faults are of the most ancient Caledonian stage and the Bekei deep-seated fault, separating the Chu-Ili anticlinorium from the Zhezkazgan-Sarysu depression, is a typical representative of this type. The latter faults represent the other type of dislocations in younger age and cut faults of the former direction and control the orientation of local folded structures. They are classified as overlap fault and have steep dislocations.

Intrusive activities are known only in the eastern part of the survey area, where they are represented by the middle-Devonian subvolcanic rhyolite, quartz porphyrite.

1-3 Ore Deposits

1-3-1 Ore Stratigraphy

Copper mineralization in the Zhaman-Aibat deposit occurs in interlayers of grey-colored sandstone, gravelstone and conglomerates, rarely aleuro-sandstone and aleuro-argillite. Commercial grade mineralization is concentrated mainly in the coarse-grained fractions which as a rule have secondary ("epigenetic") grey color and are composed of lower elements-faces of cyclothem (rhythms) of alluvial character. Fine grained primary ("syngenetic") grey subaqueous lithofaces contain little or no ore (Figure 1-4-2).

It is possible to consider that the lithological composition of the Permian-Carboniferous red sediment and petrography of the Zhaman-Aibat area do not greatly differ from that of the Zhezkazgan area formations. However, lithological variations in the cross section, their relations between the nature of the rhythm of sediment and character of the sediment, have some peculiarities.

As recognized in the Zhezkazgan ore field, the cross section of productive sediments within the ore field of the Zhaman-Aibat deposit has been preliminarily divided into Ore-bearing horizons.

The availability of reliable markers ("key beds"), such as organogenic limestone of the Serpukhov stage, interformational conglomerate and gravel of "Raimundo" type and relative persistence of interlayers of grey sandstone make such division appropriate. The generalized stratigraphic column of curpriferous sediments of the Zhaman-Aibat and Taskura ore deposit is shown in Figure 2-1-4.

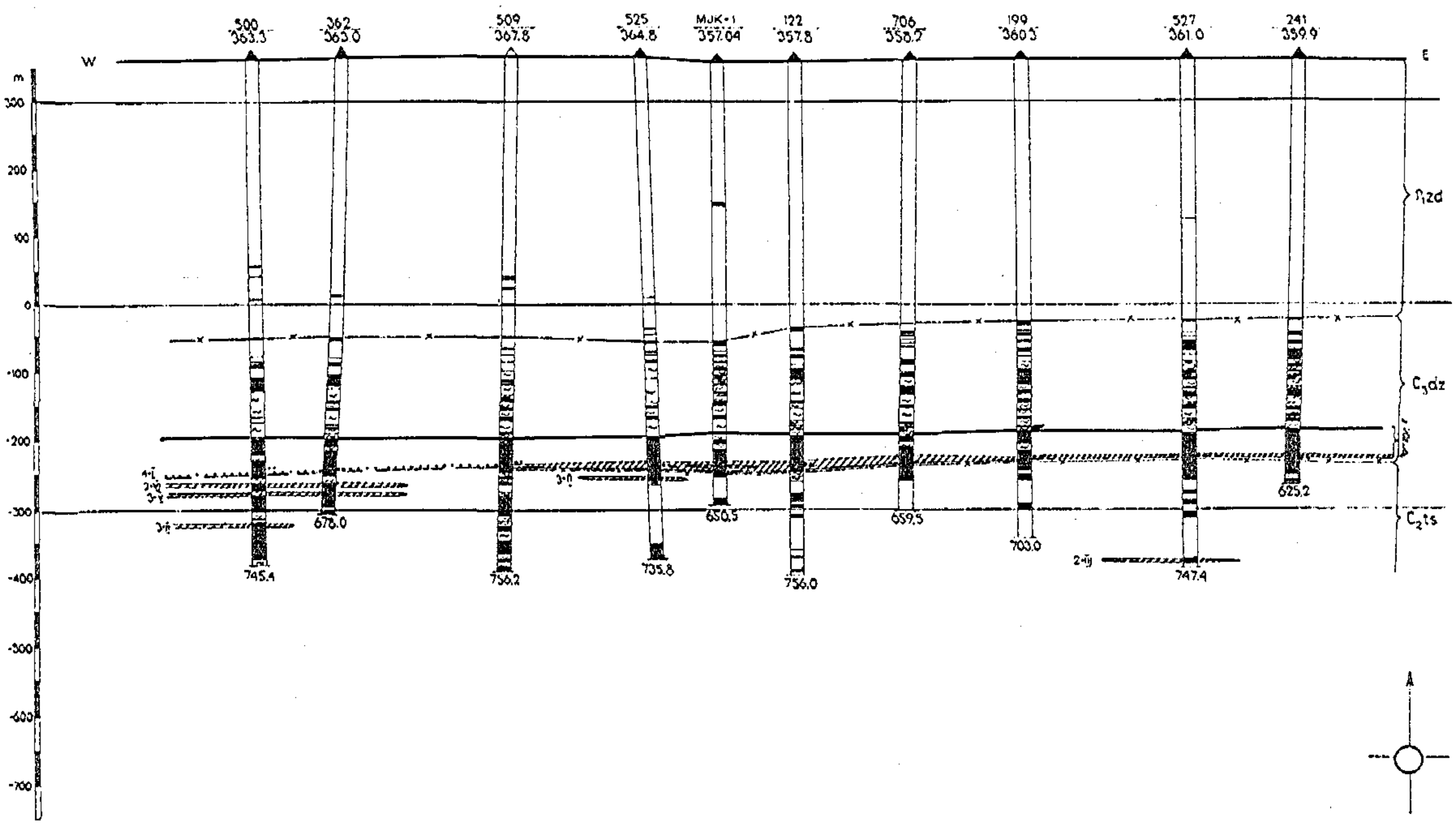
In compliance with this, it is considered that the Taskuduk formation contains 3 horizons, the Zhezkazgan Formation 7 horizons and the Zhidelisai Formation one horizon. Of these ore horizons, commercial ore grade (although most of them are not minable) is defined within 12 layers of grey fine/coarse-grained sandstone and conglomerate; horizon 2-1 layer (2-I), horizon 3-7 layers (3-0 to 3-VI), horizon 4-4 layers (4-I to 4-IV) (Figures 2-1-5 and 2-1-6).

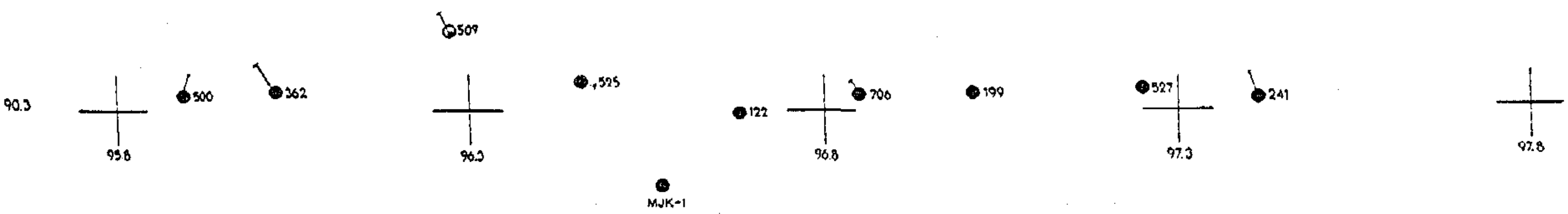
Among these horizons, major commercial mineralization is confined to the Horizon 4-I which occurs some 1～4m above the interformational ("Raimundo") conglomerate (Plates 2 and 3).

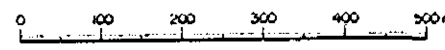
Zhezkazgangeologiya estimated that 83～85% of copper ore, 65% of silver ore, 87% of complex ore and 80～90% of zinc-lead ore are concentrated and reserved within Horizon 4-I (Figure 2-1-7).

Based on the special position, three large and several small orebodies were defined

(500·362·509·525·MJK-1 - 122·706·199)

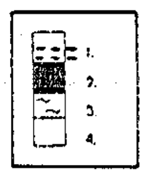




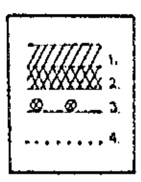


Well no	Mineralization horizon from	Mineralization horizon to	Thickness m	core recovery m	core recovery %	grade Cu %	grade Pb %	grade Zn %	grade Re g/t	grade Ag g/t	grade S %	Ore type	Deposit	Commercial characteristics
500	607.5	613.6	6.10	6.10	100	0.28	-	-	0.14	1.61	0.73	copper	4-I	mineraliz.
	624.9	629.7	4.8	4.8	100	2.32	0.48	-	2.08	7.92	1.09	-"-	3-VI	balance
	634.1	637.1	3.0	3.0	100	1.75	-	-	0.27	5.65	0.83	-"-	3-V	balance
	680.1	682.9	2.8	2.8	100	2.96	-	-	1.98	11.02	1.55	-"-	3-II	balance
509	606.05	608.85	2.8	2.8	100	0.31	0.06	0.10	0.70	4.29	1.01	-"-	4-I	mineraliz
525	602.3	610.5	8.2	8.2	100	1.59	0.23	0.14	1.63	4.33	1.39	-"-	4-I	balance
	618.4	619.05	0.65	0.65	100	2.03	0.76	-	1.6	15.4	1.12	-"-	3-VI	balance
527	586.7	588.4	1.7	1.7	100	1.64	0.29	-	1.5	8.69	0.72	-"-	4-I	balance
	737.7	739.95	2.25	2.20	98	0.77	-	-	<0.04	0.86	0.17	-"-	2-III	balance
706	589.85	597.25	7.40	7.40	100	1.19	0.09	0.05	1.02	5.71	0.80	-"-	4-I	balance
362	613.4	613.9	0.5	0.5	100	0.76	-	-	-	2.4	-	-"-	4-I	mineraliz.
	623.3	627.9	4.6	4.6	100	1.46	0.16	-	0.49	15.98	0.88	-"-	3-VI	balance
	638.3	644.6	6.3	6.3	100	0.82	-	-	0.90	2.98	1.76	-"-	3-V	balance
122	589.6	601.0	11.4	10.1	88	2.13	-	-	1.19	9.34	0.74	-"-	4-I	balance
199	587.6	592.5	4.9	4.9	100	2.63	0.14	-	2.10	25.32	0.53	-"-	4-I	balance
241	588.9	590.4	1.5	1.5	100	1.34	-	-	0.79	6.20	0.42	-"-	4-I	balance
MJK-1	598.00	605.78	7.78	7.55	97	3.78	1.17	0.03	11.2	22.7	1.47	copper	4-I	balance

LEGEND



1. Conglomerate interformational ("Raimundo")
2. Fine-coarse-grained sandstone
3. Aleurolite, aleurosandstone, sandstones (fine-grained grey)
4. Sandstone (fine-coarse-grained), aleurolite, aleurosandstone red.



Ore

1. Copper (balanced)
2. Complex (balanced)
3. Silver-containing balanced
4. Mineralization

Figure 2-1-5 Geological Cross-Section along the Line DDH500(West)-DDH241(East) showing Stratigraphic Setting of the Eastern Orebody

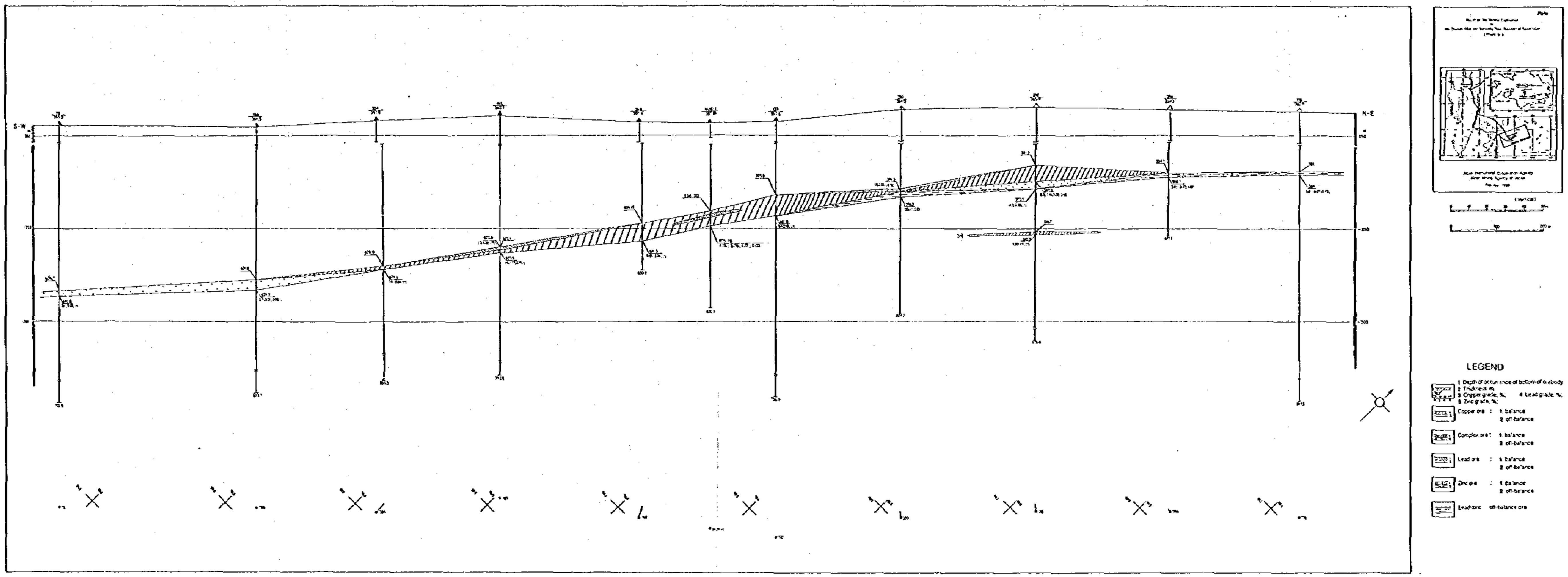


Figure 2-1-6 Geological Cross-Section along the Line DDH73(Southwest)- DDH776(Northeast) showing Stratigraphic Setting of the Eastern Orebody

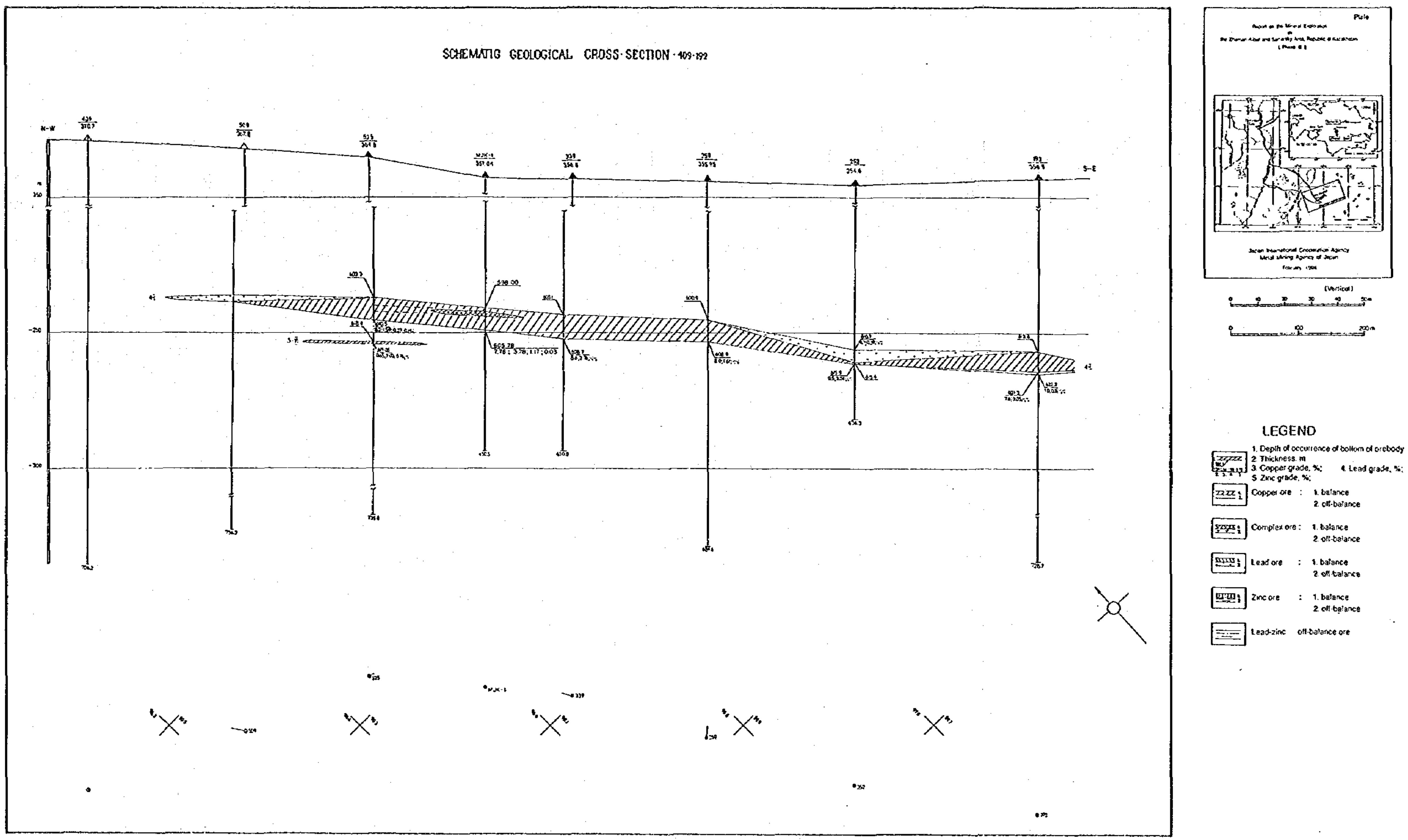


Figure 2-1-7 Geological Cross-Section along the Line DDH409(Northwest)-DDH192(Southeast) showing Stratigraphic setting of the Eastern Orebody

within Horizon 4-I. Small isometric ore bodies are defined at Horizon 4-II, 4-III, 4-IV; stratigraphycally they are located 5～20m higher than Horizon 4-I. Small ore bodies, penetrated by single drill holes, are defined at Horizon 3-0, 3-I, 3-II, 3-III, located 60～90m lower than the major Horizon 4-I.

1-3-2 Occurrence of Ore

There are three main orebodies, namely the Central, Northern and Eastern Orebodies (Figure 1-4-1 and Table 2-1-8). These orebodies are distributed in an area with dimension: approximately 12.5km in the east-west direction and approximately 5km in the north-south direction. The depth of the ore horizon is approximately 380～500m in the eastern area and the depth increases toward the west. At the western edge of the Central Orebody it reaches 700～750m. At the north western edge of the Northern Orebody, the maximum depth was confirmed to be 810m (Figure 2-1-1).

The morphology of each orebody shows a mant-like, lens-shape or band like shape with complex inner mineral structures.

1-3-3 Mineral Composition

Previous studies of mineral composition of ores at the Zhaman-Aibat deposit started in 1983 and 1,450 polished thin sections have been scanned mainly by the Kazakhstan Science-Research Institute. More than 30 minerals, falling within groups of native elements, sulfides, arsenides, oxides, sulphates, have been reported (Table 2-1-9). The mineral composition of the ore is comparatively simple. The main minerals are chalcocite group minerals, such as chalcocite with digenite and djurleite, bornite, galena and chalcopyrite are in small amounts. Accessory minerals are pyrite, marcasite, sphalerite, tennantite as primary minerals and covellite, native silver and native copper as secondary minerals. Among the rare minerals, zhezkazganite ($Cu\ Re\ S_4$) has been identified in the Zhezkazgan deposit, but have not been identified in the Zhaman-Aibat deposit.

The following micro structures are typical for ore minerals in the deposit : evenly impregnated, impregnated spotted, rim-like, banded, inherited laminated, cemented inherited and rarely veinlet (Appendices 9 and 10). In the high grade copper ore (Cu≒30%), copper minerals, mainly chalcocite are completely impregnated and represent a massive ore. (Appendices 9,10 and 11). Normal grade copper ore (Cu≒1.5~3.0%)

contains chalcocite and minor amounts of bornite impregnated in the matrix among

Table 2-1-7 Classification of Ore Type and Cut-Off Grade by the Zhezkazgangeologiya

Ore Type	Composition			Minimum Commercial Grade (Dec. 1991)
	Cu	Pb+Zn	Ag	
Cu Ore	Cu≧0.4%			Cu=0.75%
Complex Ore	Cu≧0.3%	Pb+Zn≧0.8%		Pb+Zn=0.85%
Lead-Zine Ore		Pb+Zn≧1.10%		Pb+Zn=2.25%
Silver Ore			≧5.0 g/ton	14 g/ton

Table 2-1-8 General Character on Each Orebody in the Zhaman-Aibat Ore Deposit

Orebody	Eastern	Central		Northern
Ore horizon				
main	4·I	4·I		4·I
minor	3·V～VI, 4·II～III	3·V～VI,4·II～III		3·V～VI
Ore type	mainly Cu ore	Complex (Cu+Pb+Zn) ore, Cu ore		Cu-Ag ore, Cu ore
Ore minerals				
common	chalcocite bornite	chalcocite bornite		chalcocite bornite
rare	chalcopyrite galena sphalerite	chalcopyrite galena sphalerite		native-Ag electrum chalcopyrite
very rare	native-Ag electrum	native-Ag		galena sphalerite
Ore grade		Complex ore	Cu ore	
Cu(%)	1.5～1.6	1.5～1.6	1.8～2.0	1.5～1.6
Pb(%)	—	2.0±	0.3±	0.02±
Zn(%)	—	0.3±	0.07±	—
Ag(g/t)	10～12	10～12	10～12	40～60

grains of sandstone or siltstone (aleurolite) (Appendices 9 and 10).

Table 2-1-9 List of Minerals Described in Previous Mineralogical Studies of the Zhaman-Aibat Ore Deposit

Minerals					
main		*accessory*		*rare*	
chalcocite	Cu_2S	pyrite	FeS_2	β-domeykite	Cu_3As
digenite	$Cu_{1.80}S$	marcasite	FeS_2	algodonite	Cu_6As
djurleite	$Cu_{1.96}S$	covellite	CuS	stromeyerite	$CuAgS$
bornite	Cu_5FeS_4	sphalerite	ZnS	native copper	Cu
galena	PbS	tennantite	$(Cu,Fe)_{12}As_4S_{13}$	arsenopyrite	$FeAsS$
chalcopyrite	$CuFeS_2$	native silver	Ag	loellingite	$FeAs_{2-x}$
				koutekite*	Cu_5As_2
				kutinaite*	Cu_2AgAs
				scutterudite**	$CoAs_3$
				pyrrhotite**	$Fe_{1-x}S$
				betekhtinite***	$Cu_{21}Pb_2S_{15}$
				graphite	C
				lepidocrocite	$FeOOH$
				cuprite****	Cu_2O
				anglesite****	$PbSO_4$
				safflorite***	$(Co,Fe)As_2$
				cobaltite***	$(Co,Fe)AsS$

Botsmanovsky (1991)

* : minerals, firstly described in the USSR;
** : minerals, firstly described at cupreous sandstone deposits at Zhezkazgan survey area;
*** : minerals, requiring additional methods of diagnostics;
**** : *minerals of doubtful hypogenic origin.*

Ore zonation in the Zhaman-Aibat deposit has been discussed in the previous geological and mineralogical study reports (Figure 2-1-7). The development of more robust models of zonation await further evaluation on previous large and complex data, which will provide useful informations on ore genesis of the Zhaman-Aibat copper deposit.

1-3-4 Ore type

With the assemblage of ore minerals, six ore types, namely copper ore (Cu), complex ore (Cu+Pb+Zn), lead-zinc ore (Pb+Zn), lead ore (Pb), zinc ore (Zn) and silver ore (Ag) are classified by the Zhezkazgangeologiya. Silver is contained in the all types of ore but higher silver contents has been reported in the ore types of copper ore, complex ore and silver ore.

It is estimated that 94~98% of copper and complex ore reserves are concentrated within 50~60m vertical, which contains Horizon 4-I, 4-II ,3-V and 3-VI.

Overviewing the Horizon 4-I of each orebody, the Eastern orebody mainly contains relatively higher grade copper ore with relatively thicker ore layer. In the type of copper ore, chalcocite type with small amount of djurleite and digenite is widely occurring in ore-bearing horizons of the Taskuduk and the Zhezkazgan Formation (Figure 2-1-8), frequently composing the richest spots of ore deposits. It is characterized by impregnared striped, spotted and inherited cement structure. Silver is associated with chalcocite ores as silver rich electrum, stromeyerite and native Ag (not confirmed yet in this year's campaign). This type of ore is predominant in the Eastern Orebody.

Type of complex ore shows several type of the mineral assemblage (Figure 2-1-8). Chalcocite-bornite-galena type widely spread mainly at the Central Orebody and partially at the Northern Orebody. At the Central Orebody it composes the most rich, even massive complex ores. The ore of this type shows impregnated, banded, laminated, inherited cemented and displacement structures. Chalcopyrite-galena type is widely spread and composes relatively poor complex ore of Taskuduk and Zhezkazgan Formation. Impregnated and displacement structures are the most typical ones. Chalcocite-bornite-galena-sphalerite type is rare and sporadically occurs in sediments of Zhezkazgan Formation at the Central Orebody and rarely at the Eastern Orebody. Chalcopyrite-galena-sphalerite type is moderately spread at the area and represents impregnated and displacement structures. Chalcocite-sphalerite type is the rather rare and represents an intensive impregnated structure.

Galena type is one of the most widely spread ore types. It is the most typical for lead and lead-Zinc ore. This ore type is characterized by impregnared, cemented, laminated, relic type structures as well as displacement structures. Galena-sphalerite type is quite typical for nucleus part of the Central Orebody and it is characterized by impregnated structure as well as by relict and displacement structure. Sphalerite type is predominant in the Central Orebody and the southern part of the Northern Orebody, representing impregnation and concretion within the rock cement.

1-4 Verification of Chemical Assay Data

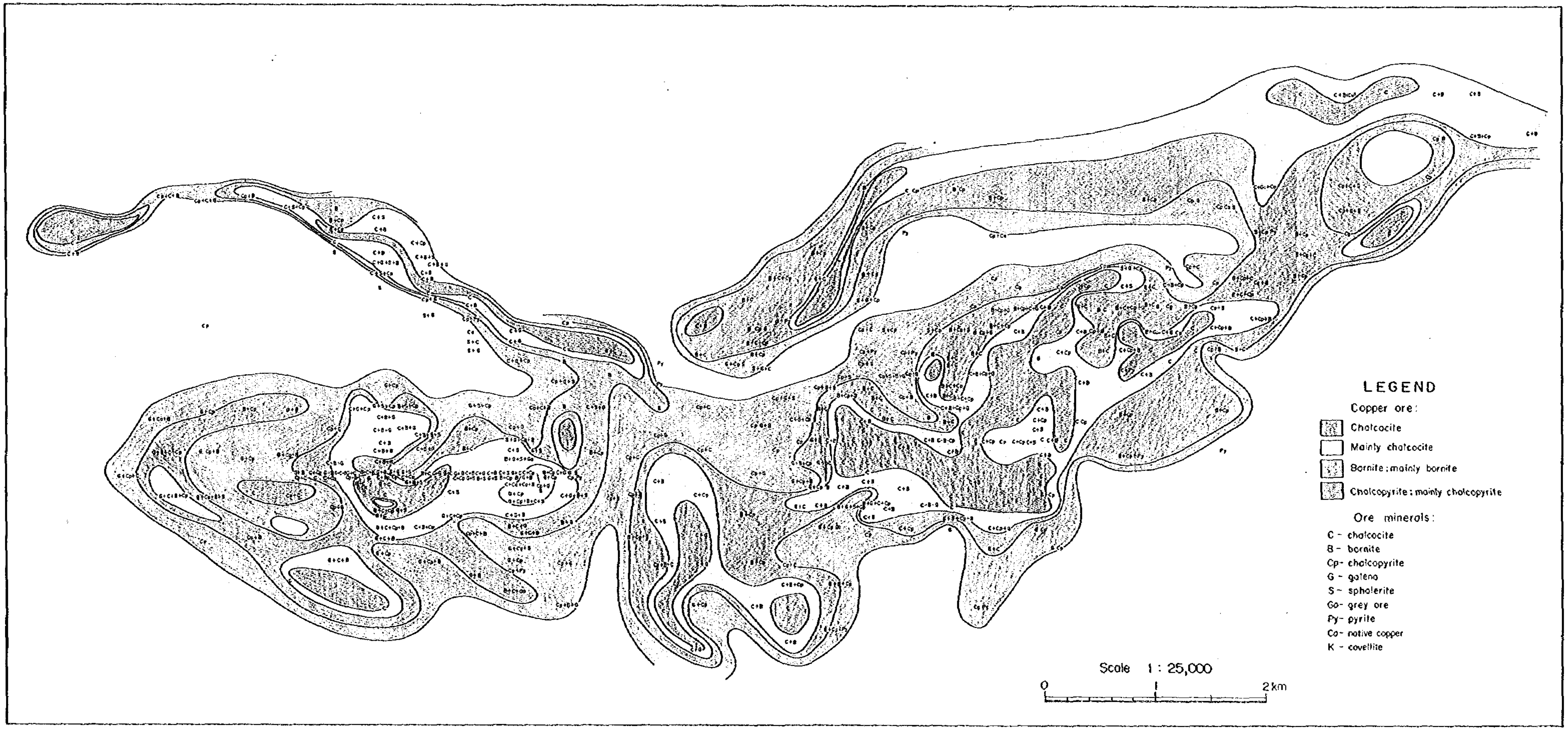


Figure 2-1-8 Contour Map of the Copper Mineral Assembledge of the Zhaman-Aibat Ore Deposit

In order to confirm validity of the chemical assay data, a total of 35 check samples were selected and re-analyzed in the Canadian Laboratory by the atomic absorption spectrometry assay method. The assay results are summarized in Appendix 1 and 35 pairs of assay results in two scatter plots on both Cu (%) and Ag (g/t) shown in Figure 2-1-9. The correlation between copper analyses by the Zhezkazgangeologiya Laboratory and Canadian Laboratory is very high with correlation coefficient 0.996. Silver assay results are some what erratic and silver correlation is lower than copper's. But silver correlation is as high as 0.938. Overall trends of copper and silver are extremely coincident and are regarded as satisfactory. The assay results of two laboratories are also checked by the Japanese laboratory and are in agreement.

1-5 Data Base Construction

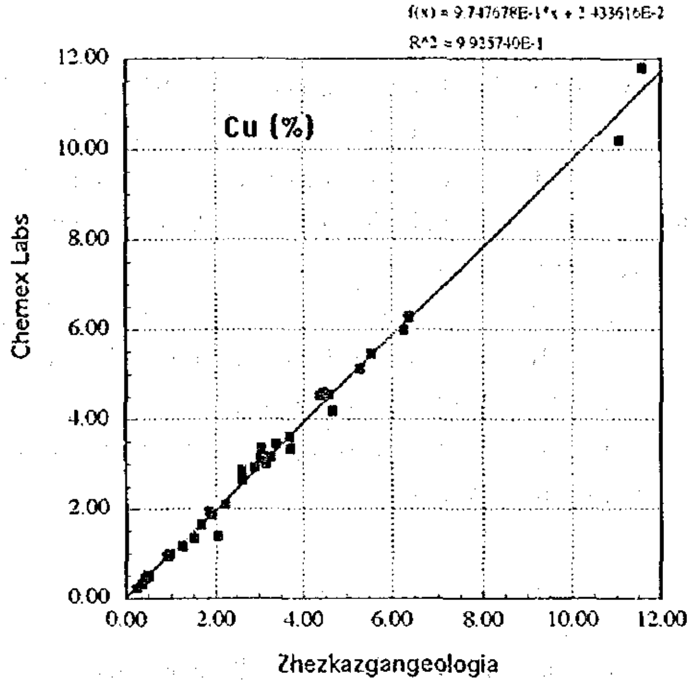
For the ore reserve estimation, construction of the Zhaman-Aibat deposit data base has been started. Input parameters to this data base are ; drill number, coordinates (x,y,z), drilled length (m) drill hole inclination (degree) and azimuth (degree), and chemical assay data (Cu,Pb,Zn,Ag) and name of ore horizon (Table 1-1-4). Chemical assay data on minor elements, such as Re,Os,Ca,P,Sb,V,Hg and Se as well as total and sulphide sulphur, contain many difficulties to vary by chemical analyzed value due to the lower reliability of previous assay data.

For the second straight year a total of 402 drill holes data and 3,851 points of chemical analysis data were inputted to the Zhaman-Aibat deposit data base (Table 1-1-4).

As aforementioned above, extensive drilling exploration is being carried out in the Zhaman-Aibat copper deposit. The total amount of drilling has reached 996 holes with total length of 632,467.4m. Drilling statistics from 1981 to 1995 are shown in Table 2-1-1.

The drill holes are generally located on 200m×200m (category C_1) or a 400m×400m (category C_2) grid basis in the former USSR standard. On some of the grid lines, drills are spaced at 100m to provide move detailed information. In addition to 825 exploration drill holes, 171 holes have been drilled to collect samples for metallurgical test. Locations of all drill holes are shown in Figure 2-1-10, (together with outlines of individual orebodies.)

Drill cores were split in half by the Zhezkazgangeologiya and one half was pulverized



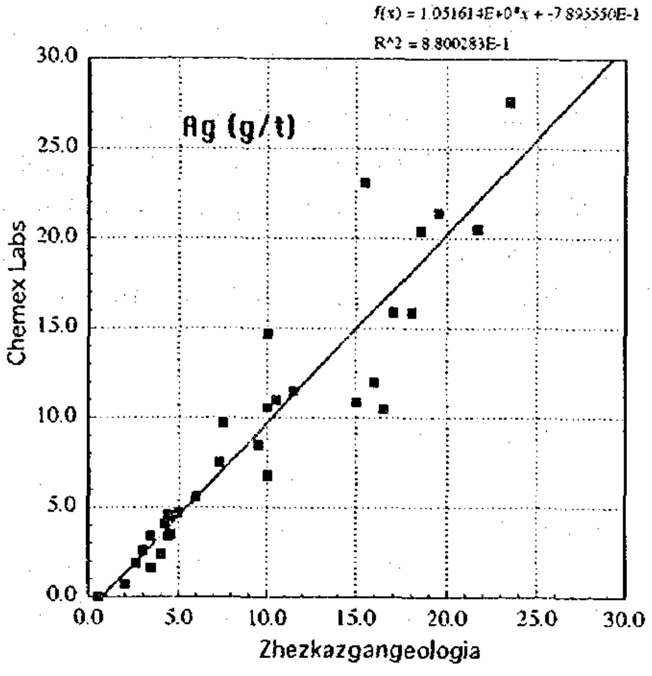


Figure 2-1-9 Scatter Plot of Check Analysis of ore samples from the Zhaman-Aibat Ore Deposit (Zhezkazgangeologiya Labs. vs Chemex Labs.)

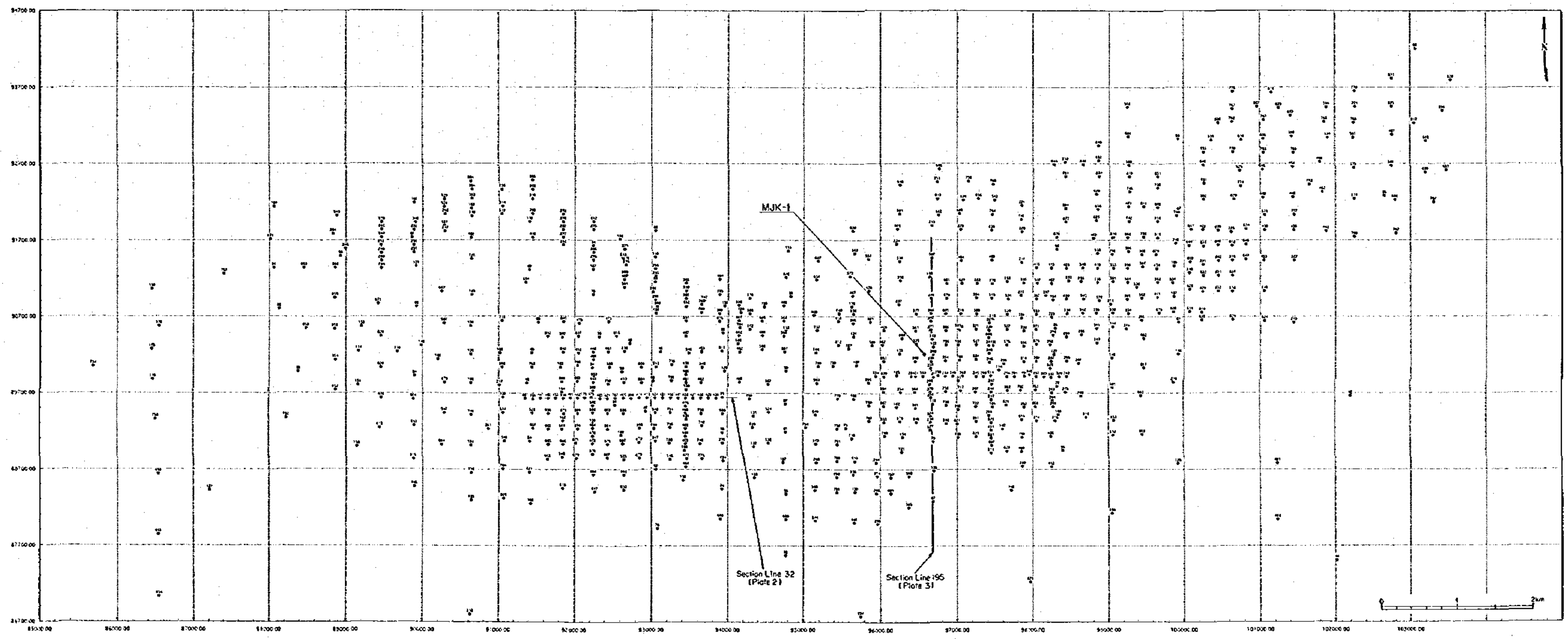


Figure 2-1-10 Location Map of Drill Holes in the Zhaman-Aibat Area