第Ⅲ部　結論および第２年次への提言

第Ⅲ部　結論および第２年次への提言

第１章　結　論

ウム・アダマール地域における第１年次調査として，既存データ解析，航空写真解析，地質調査およびIP法物理探査が実施し，以下の結論を得た。

1. 調査地域の地質は，原生代後期 Arj 層群の安山岩，石英安山岩および流紋石英安山岩，同質火砕岩よりなり，閃緑岩，石英閃緑岩，トーナル岩，安山岩，石英安山岩等に貫かれる。これらを不整合に被覆して原生代後期 Mahd 層群の安山岩，火砕岩が調査地域の西端部に分布する。

2. 調査地域には，Umm ad Damar North，Umm ad Damar South，4/6 Gossan の既知プロスペクトが分布する。これらのプロスペクトでは，epigenetic な熱水鉱化作用により形成された Arj 層群中の剪断帯に鉱染状ないし網状に胚胎する鉱化帯が Umm ad Damar North で５列（No.1～No.5），Umm ad Damar South で１列，4/6 Gossan で１列存在するものと推定される。Umm ad Damar North と Umm ad Damar South の鉱化帯では黄銅鉱・黄鉄鉱を主とするが，Umm ad Damar South の鉱化帯の地表部で採取した試料の分析結果から，本鉱化帯は Au を伴うものと推定される。また，4/6 Gossan の鉱化帯では Cu の他に Au，Ag，Pb，Zn 品位が高い。

3. これらの鉱化帯に対して，既に地質調査，IP 法物理探査，地化学探査，トレンチ調査，試錐探査が実施されているが，鉱化帯の下部および延長部に対しては十分な探鉱は行われていない。また，調査地域の約 60%を占める現世の砂礫層分布域においても十分な探鉱は行われていない。

4. 本年度に実施したこれら３プロスペクトにおける地質精査データおよび過去に実施した試錐探査のデータを総合的に検討した結果，Umm ad Damar North のカラミ分布域の下方，Umm ad Damar South の鉱化帯の西部，4/6 Gossan の鉱化帯の下部と南部には探鉱余地があると考えられる。

5. IP 法物理探査により Jabal Sujarah（“B-12” 異常域），Umm ad Damar North の No.3 鉱化帯の南東方延長部（“J-25” 異常域），Umm ad Damar North と Umm ad Damar South プロスペクトの中間地点（“M-27” 異常域），および Umm ad Damar South プロスペクトの西端部（“P-18” 異常域）の４箇所で 24 mV/V 以上の強い充電率異常を抽出した。

6. 上記異常域のうち，“J-25”異常域はNW-SE走向のNo.3鉱化帯とNo.4鉱化帯の中間に位置する。“M-27”異常域と“P-18”異常域はNE-SW方向の断層付近に分布し，“M-27”異常域の近傍には酸化銅鉱を含む石英脈や古代採掘跡が分布する。“B-12”異常域では，炭酸塩化作用が著しく，NE-SWおよびNW-SE方向の断層の交差部に位置する。また，ジャスパーや流紋石英安山岩が分布するなど，地表地質はJabal Sayid鉱床に類似する。これらの異常域では比抵抗が高く，物性試験の結果などからも，これらの充電率異常は地下深部に胚胎する硫化物鉱体を反映したものと考えられる。

第２章　第２年次への提言

２－１　試錐探査

Umm ad Damar North：No.2鉱化帯は，その大部分がカラミに覆われているため，全貌が明らかではない。これまで実施されていなかった試錐探査が必要である。また，“J-25”異常域はSoutheast HillのNo.3鉱化帯とSoutheast ExtensionのNo.4鉱化帯の中間に位置しており，本異常域に向けた試錐探査が必要である。

4/6 Gossan：充電率異常の分布域が小さいため，大規模な鉱化帯は期待できないが，鉱化帯はAu，Agに富むことから，本鉱化帯の深部およびUAD-13号より南方で試錐探査を実施し，本鉱化帯のポテンシャルを明らかにする必要がある。

２－２　精密物理探査

以下の地域において次段階の探査が望まれる。

“B-12”異常域：調査地域内では最も強い充電率異常域である。今回のIP法物理探査は測線間隔が300mと広いために，本異常域の方向および中心が不明であり，ただちに試錐探査に移行できない。測線間の距離を100m程度とした，IP法物理探査およびTEM法物理探査を実施する必要がある。

“M-27”異常域から“P-18”異常域にかけての範囲：両異常域はNE-SW走向の弱線部に胚胎する鉱化帯を示唆しているものと推定され，両異常域を含む範囲において，測線間の距離を100m程度としたIP法物理探査，およびTEM法物理探査を実施し，異常の連続性と中心を明らかにする必要がある。

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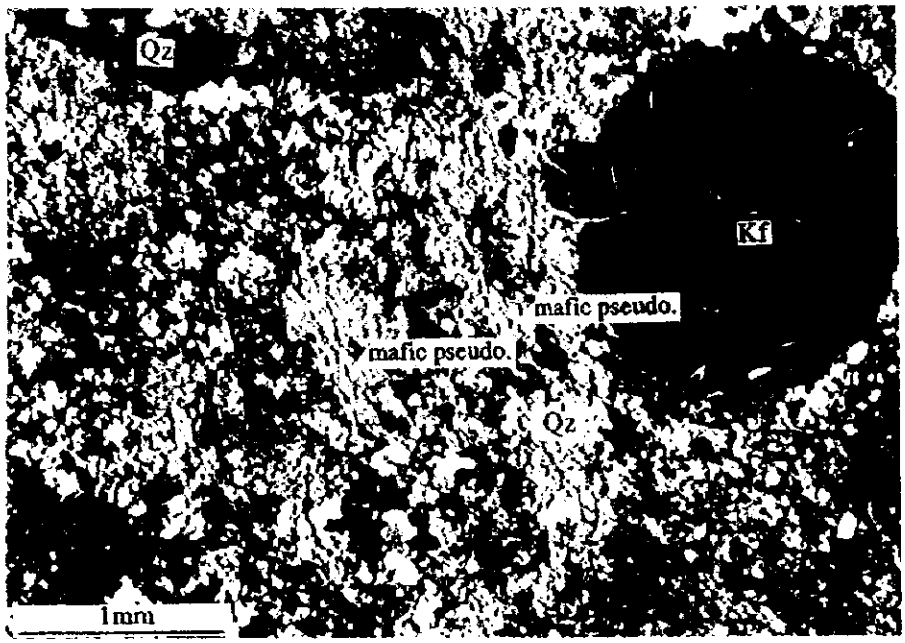
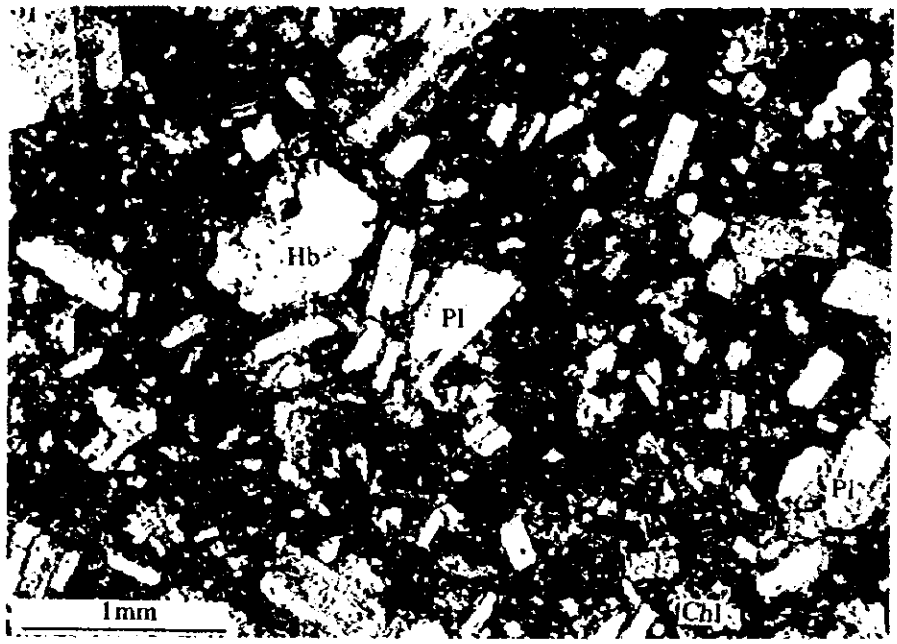
写　真



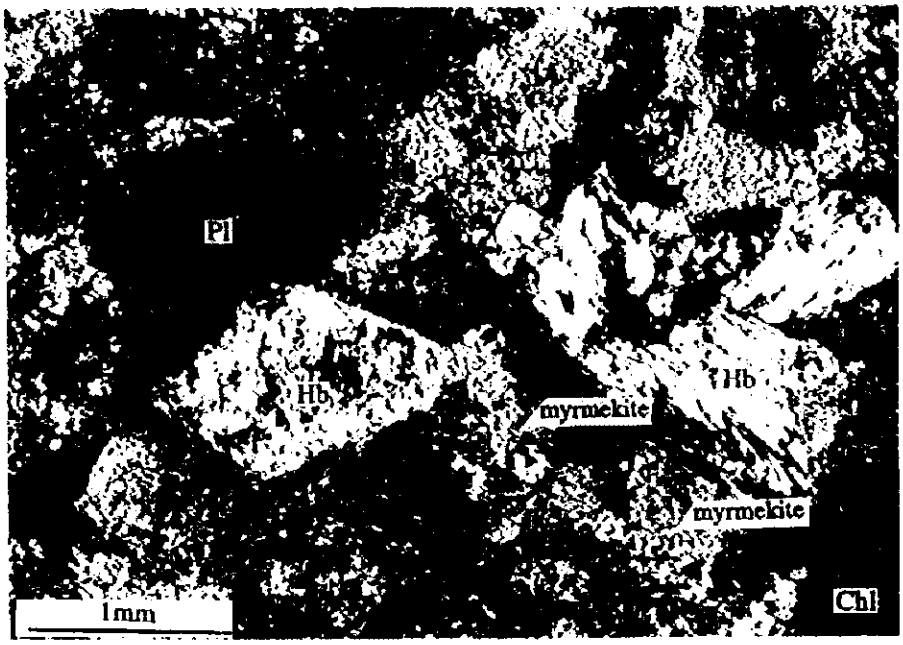
Rock Name: Dacite (Arj Group)
Sample No.: K9022701
Locality: Umm ad Damar North
(Crossed Nicol)



Rock Name: Tuff Breccia (Mahd Group)
Sample No.: M9022013
Locality: Northwest of Jabal Sujarah
(Crossed Nicol)

Abbreviation Pl: Plagioclase, Hb: Hornblende, Chl: Chlorite, Qz: Quartz, Kf: K-feldspar

Photo 1 Photomicrographs of Thin Sections (1)



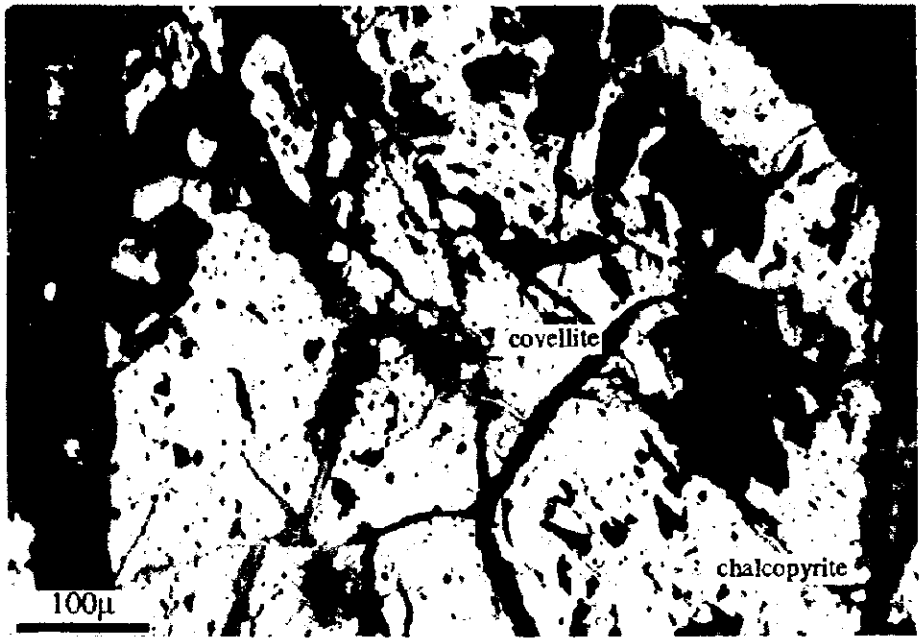
Rock Name: Porphyritic Diorite
Sample No.: K9022005
Locality: Southeastern Margin of Umm ad Damar North Prospect
(Crossed Nicol)

Rock Name: Tonalite
Sample No.: K9021302
Locality: North of Umm ad Damar South Prospect
(Crossed Nicol)

Abbreviation Pl: Plagioclase, Hb: Hornblende, Chl: Chlorite, Qz: Quartz

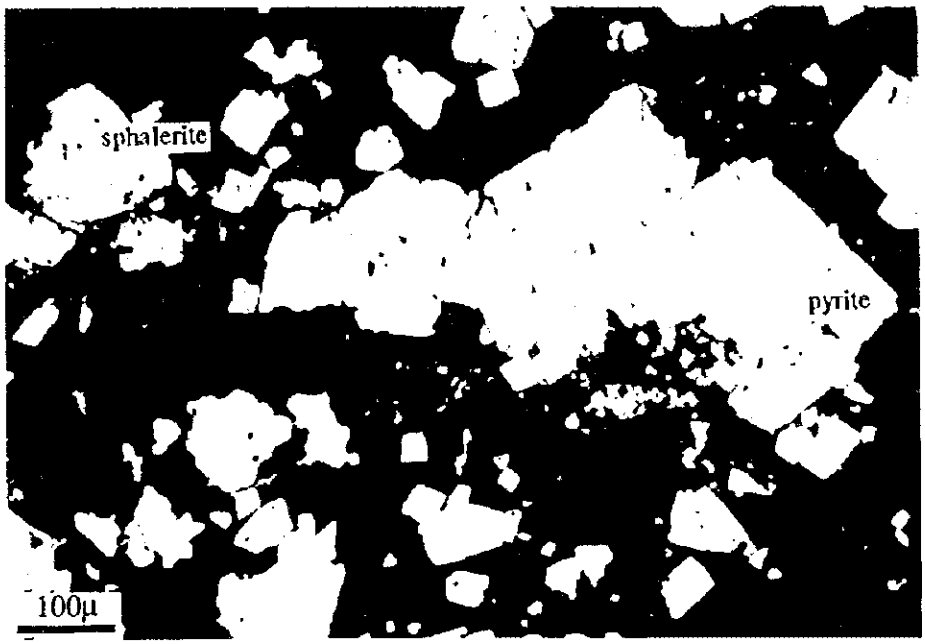
Photo. 1 Photomicrographs of Thin Sections (2)

Minerals: Hematite
Sample No.: K9030102
Locality: Umm ad Damar North
(Open Nicol)



Minerals: Chalcopyrite-Covellite
Sample No.: K9021409
Locality: Southeast Extension of Umm ad Damar South
(Open Nicol)

Photo. 2 Photomicrographs of Ores (1)

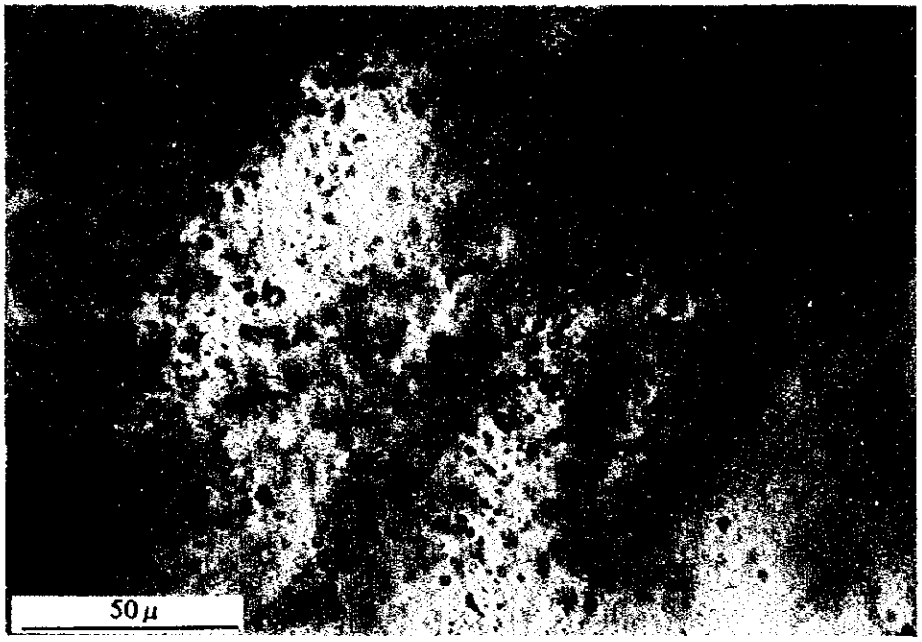


Minerals: Sphalerite-Pyrite
Sample No.: K9030301
Locality: Umm ad Damar North, UAD-6
(Open Nicol)

Minerals: Chalcopyrite-Pyrite-Pyrrhotite
Sample No.: K9030301
Locality: Umm ad Damar North, UAD-6
(Open Nicol)

Photo. 2 Photomicrographs of Ores (2)

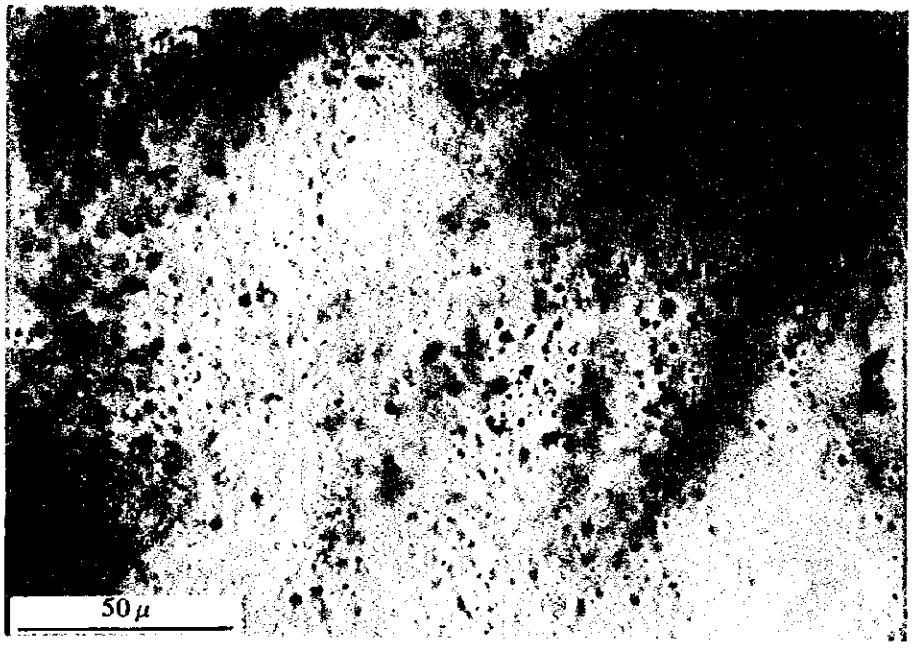
Inclusion Type: Liquid-rich Two-phase
Sample No.: K9030307
Locality: Jabal Sayid Deposits



Inclusion Type: Liquid-rich Two-phase
Sample No.: K9030103
Locality: Umm ad Damar North

Photo. 3 Photomicrographs of Fluid Inclusions (1)

Inclusion Type: Liquid-rich Two-phase
Sample No.: K9030301
Locality: Umm ad Damar North, UAD- 6

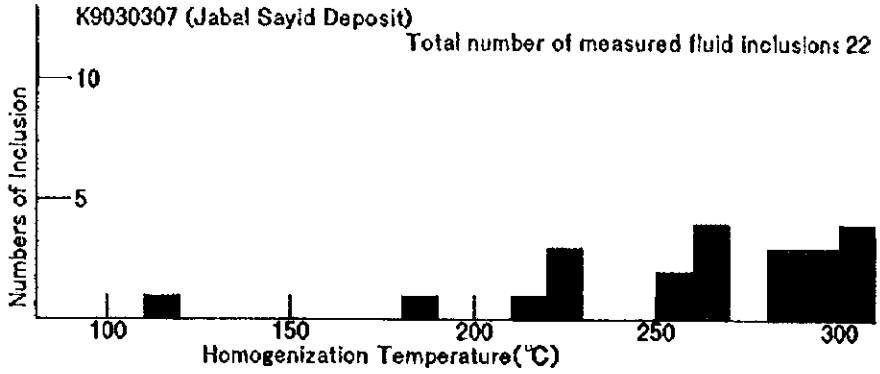


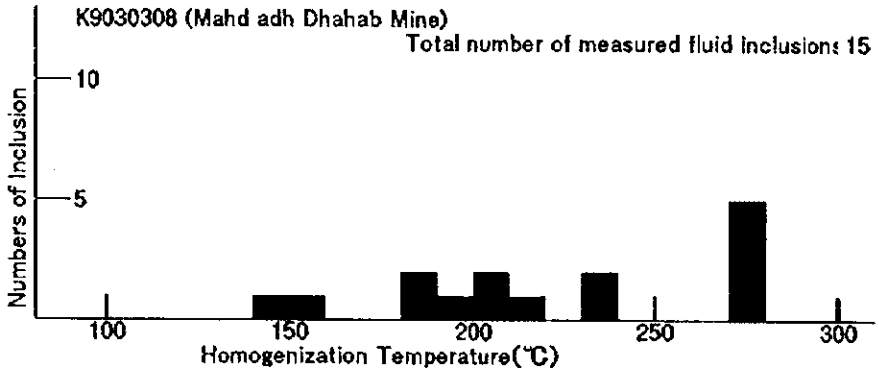
Inclusion Type: Liquid-rich Two-phase
Sample No.: K9022403
Locality: Umm ad Damar South Prospect

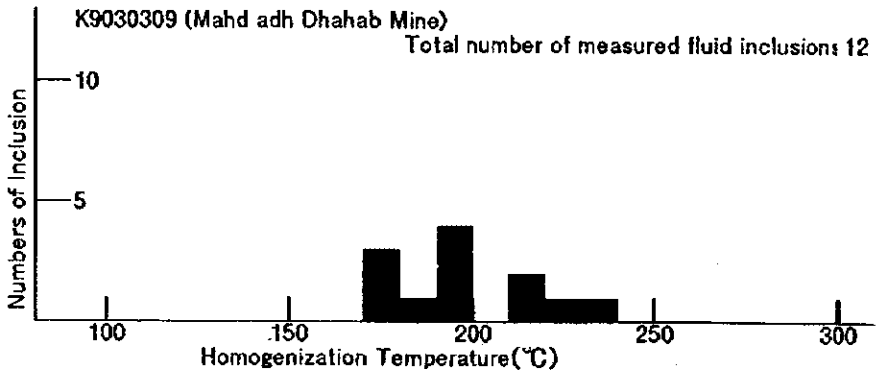
Photo. 3 Photomicrographs of Fluid Inclusions (2)

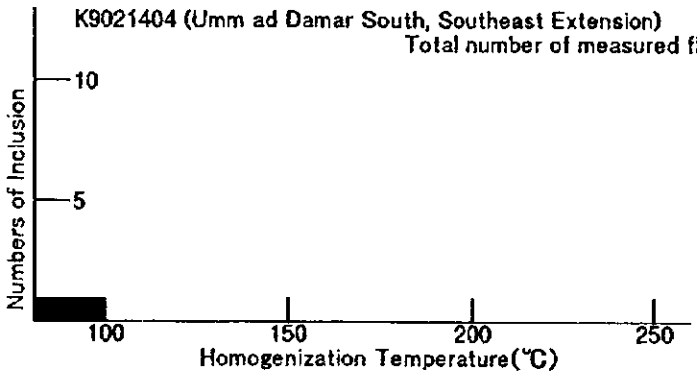
付帯資料

Appendix-1 Histogram of Homogenization Temperature (1/3)

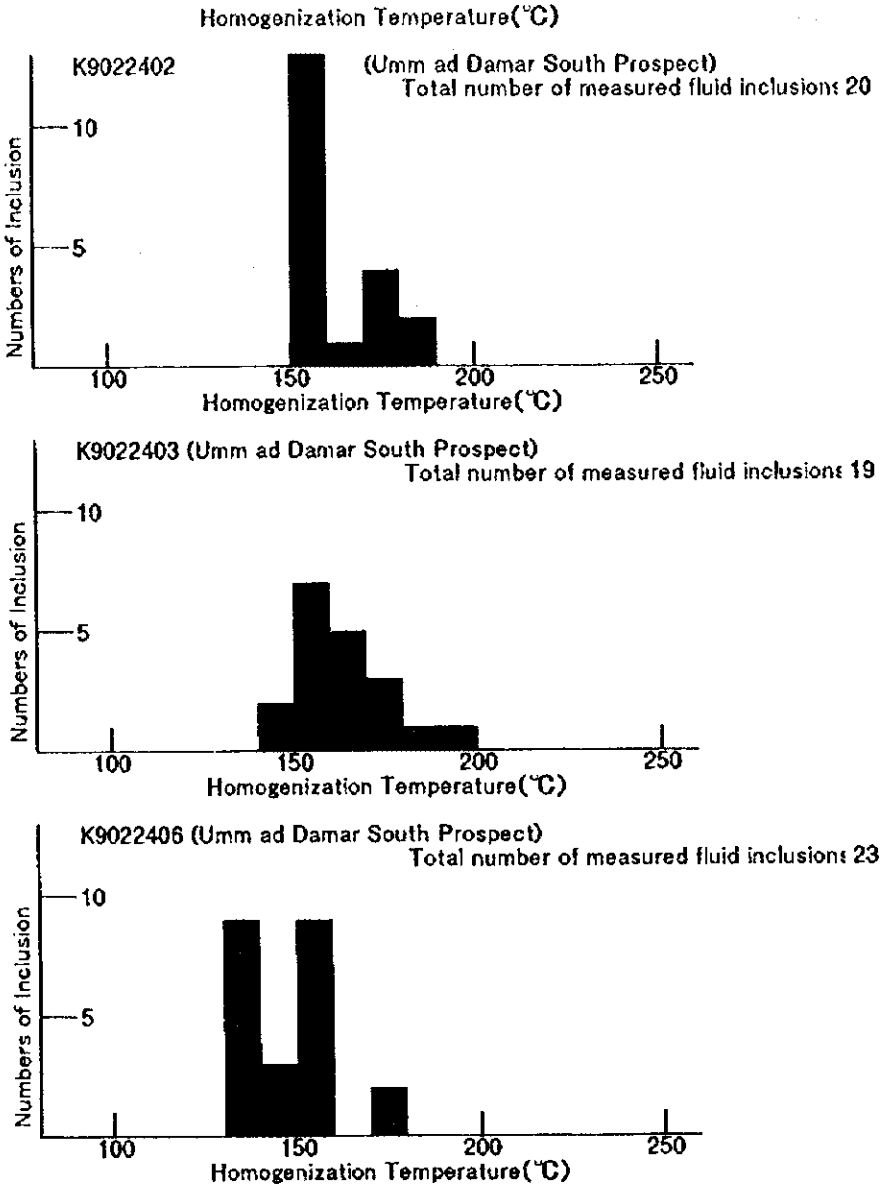




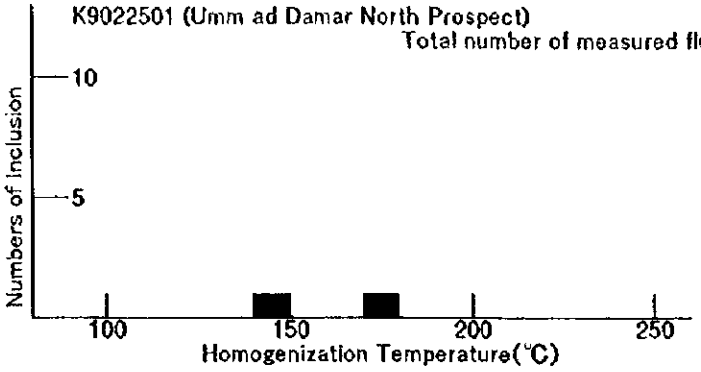


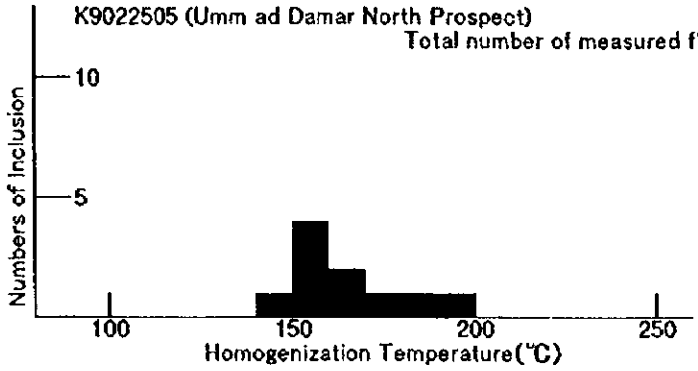


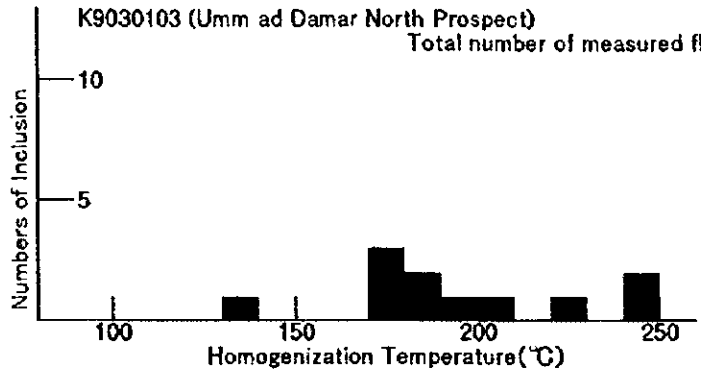
Appendix-1 Histogram of Homogenization Temperature (2/3)



Appendix-1 Histogram of Homogenization Temperature (3/3)







Appendix-2 Characteristics of Measured Fluid Inclusions

Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
K9022006	006-1	quartz	5	irregular	Liquid only		13.3	14.4	2-phase inclusion was not confirmed.
	006-2	quartz	5	irregular	Liquid only		11.6	12.3	
							(Average of salinity)	13.3	
							(STDEV of salinity)	1.5	
K9030102	102-1	quartz	5	irregular	Liquid only		11.8	12.5	2-phase inclusion was not confirmed.
	102-2	quartz	5	irregular	Liquid only		11.7	12.4	
	102-3	quartz	4	elliptical	Liquid only		11.1	11.7	
							(Average of salinity)	12.2	
							(STDEV of salinity)	0.4	
K9030103	102-1	quartz	3	irregular	Liquid only		7.6	6.8	
	102-2	quartz	5	irregular	Liquid only		7.7	7.0	
	102-3	quartz	3	elliptical	Liquid-rich 2-phase	183	6.4	4.9	Homogenized into a single liquid phase.
	102-4	quartz	3	irregular	Liquid-rich 2-phase	190	6.4	4.9	
	102-5	quartz	4	irregular	Liquid-rich 2-phase	220	7.7	7.0	
	102-6	quartz	5	elliptical	Liquid-rich 2-phase	179	7.6	6.8	
	102-7	quartz	3	irregular	Liquid-rich 2-phase	240	7.1	6.0	
	102-8	quartz	5	elliptical	Liquid-rich 2-phase	243	8.0	7.3	
	102-9	quartz	4	elliptical	Liquid-rich 2-phase	139	6.7	5.4	
	102-10	quartz	4	elliptical	Liquid-rich 2-phase	172			
	102-11	quartz	2	irregular	Liquid-rich 2-phase	174			
	102-12	quartz	4	irregular	Liquid-rich 2-phase	184	7.6	6.8	
	102-13	quartz	5	irregular	Liquid-rich 2-phase	202	6.9	5.7	
					(Average of Homo. Temp.)	193	(Average of salinity)	6.2	
					(STDEV of Homo. Temp.)	31	(STDEV of salinity)	0.9	

Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
K9022501	501-1	quartz	8	irregular	Liquid only		12.6	13.5	
	501-2	quartz	5	irregular	Liquid only		12.5	13.4	
	501-3	quartz	5	irregular	Liquid only		12.3	13.1	
	501-4	quartz	2	elliptical	Liquid-rich 2-phase	175			Homogenized into a single liquid phase.
	501-5	quartz	3	elliptical	Liquid-rich 2-phase	147			
					(Average of Homo. Temp.)	161	(Average of salinity)	13.4	
					(STDEV of Homo. Temp.)	20	(STDEV of salinity)	0.2	
K9022505	505.1.1-1	quartz	4	irregular	Liquid-rich 2-phase	171	17.2	18.4	Homogenized into a single liquid phase.
	505.1.1-2	quartz	3	irregular	Liquid-rich 2-phase	181	12.0	12.8	
	505.1.1-3	quartz	4	irregular	Liquid-rich 2-phase	147	11.7	12.4	
	505.1.1-4	quartz	4	irregular	Liquid-rich 2-phase	150	14.2	15.3	
	505.1.1-5	quartz	3	elliptical	Liquid-rich 2-phase	164			
	505.1.1-6	quartz	3	irregular	Liquid-rich 2-phase	158			
	505.1.1-7	quartz	8	irregular	Liquid-rich 2-phase	191			
	505.1.1-8	quartz	3	irregular	Liquid-rich 2-phase	165			
	505.1.1-9	quartz	3	irregular	Liquid-rich 2-phase	156			
	505.1.1-10	quartz	3	irregular	Liquid-rich 2-phase	158			
					(Average of Homo. Temp.)	164	(Average of salinity)	14.7	
					(STDEV of Homo. Temp.)	14	(STDEV of salinity)	2.8	
	402.1.1-1	quartz	8	irregular	Liquid-rich 2-phase	154	0.9	1.5	Homogenized into a single liquid phase.
	402.1.1-2	quartz	3	elliptical	Liquid-rich 2-phase	150			
	402.1.1-3	quartz	3	irregular	Liquid-rich 2-phase	150			
	402.1.1-4	quartz	5	irregular	Liquid-rich 2-phase	152			
	402.1.1-5	quartz	4	elliptical	Liquid-rich 2-phase	173			
	402.1.1-6	quartz	4	irregular	Liquid-rich 2-phase	167			
	402.1.2-1	quartz	8	irregular	Liquid-rich 2-phase	172	5.3	3.1	

Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
K9022402	402.1.2-2	quartz	3	elliptical	Liquid-rich 2-phase	150			
	402.1.2-3	quartz	3	elliptical	Liquid-rich 2-phase	150			
	402.1.2-4	quartz	3	elliptical	Liquid-rich 2-phase	152			
	402.1.2-5	quartz	5	irregular	Liquid-rich 2-phase	152			
	402.1.2-6	quartz	4	irregular	Liquid-rich 2-phase	179			
	402.1.3	quartz	9	irregular	Liquid only		5.5	3.4	
	402.1.4-1	quartz	6	irregular	Liquid-rich 2-phase	152	5.9	4.1	
	402.1.4-2	quartz	5	elliptical	Liquid-rich 2-phase	180	5.7	3.8	
	402.1.4-3	quartz	3	irregular	Liquid-rich 2-phase	152			
	402.1.4-4	quartz	4	elliptical	Liquid-rich 2-phase	150			Homogenized into a single liquid phase.
	402.1.4-5	quartz	3	irregular	Liquid-rich 2-phase	150			
	402.1.4-6	quartz	4	irregular	Liquid-rich 2-phase	175			
	402.1.4-7	quartz	5	irregular	Liquid-rich 2-phase	156			
	402.1.4-8	quartz	5	irregular	Liquid-rich 2-phase	181			
					(Average of Homo. Temp.)	160	(Average of salinity)	3.2	
					(STDEV of Homo. Temp.)	12	(STDEV of salinity)	1.0	
K9022403	403.1.1-1	quartz	6	irregular	Liquid-rich 2-phase	162	6.1	4.4	
	403.1.1-2	quartz	6	irregular	Liquid-rich 2-phase	176	5.9	4.1	
	403.1.1-3	quartz	5	elliptical	Liquid-rich 2-phase	149			
	403.1.1-4	quartz	5	irregular	Liquid-rich 2-phase	149			
	403.1.1-5	quartz	3	elliptical	Liquid-rich 2-phase	156			
	403.1.1-6	quartz	3	irregular	Liquid-rich 2-phase	157			
	403.1.1-7	quartz	3	elliptical	Liquid-rich 2-phase	158			
	403.1.1-8	quartz	3	irregular	Liquid-rich 2-phase	176			
	403.1.2-1	quartz	9	irregular	Liquid-rich 2-phase	167	6.1	4.4	
	403.1.2-2	quartz	4	irregular	Liquid-rich 2-phase	164	6.4	4.9	Homogenized into a single liquid phase.

Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
	403.1.2-3	quartz	4	irregular	Liquid-rich 2-phase	191	5.8	3.9	
	403.1.2-4	quartz	3	irregular	Liquid-rich 2-phase	156			
	403.1.2-5	quartz	3	irregular	Liquid-rich 2-phase	179			
	403.1.2-6	quartz	3	irregular	Liquid-rich 2-phase	163			
	403.1.3-1	quartz	5	irregular	Liquid-rich 2-phase	154			
	403.1.3-2	quartz	3	irregular	Liquid-rich 2-phase	152			
	403.1.3-3	quartz	5	irregular	Liquid-rich 2-phase	184			
	403.1.3-4	quartz	4	irregular	Liquid-rich 2-phase	159			
	403.1.3-5	quartz	5	irregular	Liquid-rich 2-phase	163			
					(Average of Homo. Temp.)	164	(Average of salinity)	4.4	
					(STDEV of Homo. Temp.)	12	(STDEV of salinity)	0.4	
	406.1.1-1	quartz	8	elliptical	Liquid-rich 2-phase	150	6.7	5.4	
	406.1.1-2	quartz	4	irregular	Liquid-rich 2-phase	138	6.6	5.2	
	406.1.1-3	quartz	4	elliptical	Liquid-rich 2-phase	135	6.7	5.4	
	406.1.1-4	quartz	7	irregular	Liquid-rich 2-phase	139	6.5	5.1	
	406.1.1-5	quartz	3	irregular	Liquid-rich 2-phase	134			
	406.1.1-6	quartz	4	elliptical	Liquid-rich 2-phase	139			
	406.1.1-7	quartz	5	irregular	Liquid-rich 2-phase	138			
	406.1.1-8	quartz	5	irregular	Liquid-rich 2-phase	134			
	406.1.2-1	quartz	4	elliptical	Liquid-rich 2-phase	147	6.8	5.6	
	406.1.2-2	quartz	5	elliptical	Liquid-rich 2-phase	132	5.6	3.6	
	406.1.2-3	quartz	4	irregular	Liquid-rich 2-phase	148			
K9022406	406.1.2-4	quartz	5	irregular	Liquid-rich 2-phase	156			Homogenized into a single liquid phase.
	406.1.2-5	quartz	3	irregular	Liquid-rich 2-phase	132			
	406.1.2-6	quartz	4	irregular	Liquid-rich 2-phase	147			
	406.1.3-1	quartz	5	elliptical	Liquid-rich 2-phase	152			

Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
	406.1.3-2	quartz	4	elliptical	Liquid-rich 2-phase	175			
	406.1.3-3	quartz	5	irregular	Liquid-rich 2-phase	157			
	406.1.3-4	quartz	7	irregular	Liquid-rich 2-phase	153			
	406.1.3-5	quartz	3	elliptical	Liquid-rich 2-phase	159			
	406.1.3-6	quartz	3	irregular	Liquid-rich 2-phase	150			
	406.1.3-7	quartz	10	irregular	Liquid-rich 2-phase	153			
	406.1.3-8	quartz	3	irregular	Liquid-rich 2-phase	156			
	406.1.3-9	quartz	5	irregular	Liquid-rich 2-phase	175			
					(Average of Homo. Temp.)	148	(Average of salinity)	5.0	
					(STDEV of Homo. Temp.)	12	(STDEV of salinity)	0.7	
K9021402	402-1	quartz	10	irregular	Liquid only		3.8	0.5	2-phase inclusion was not confirmed.
K9021404	404-1	quartz	3	elliptical	Liquid-rich 2-phase	81			Liquid CO2?
	404-2	quartz	3	elliptical	Liquid-rich 2-phase	90			
					(Average of Homo. Temp.)	85			
					(STDEV of Homo. Temp.)	6			
	309-1-1	quartz	100	rectangular	Liquid-rich 2-phase		0.0	0.1	
	309-1-2	quartz	12	rectangular	Gas-rich 2-phase		0.1	0.3	Measurement of homo. temp. was impossible, because of disappearance of gas-phase after cooling.
	309-1-3	quartz	14	irregular	Liquid-rich 2-phase		0.0	0.1	
	309-1-4	quartz	11	irregular	Liquid-rich 2-phase		0.3	0.4	
	309-1-5	quartz	20	irregular	Liquid-rich 2-phase		0.0	0.1	
	309-1-6.1	quartz	8	irregular	Liquid-rich 2-phase	220			
	309-1-6.2	quartz	8	irregular	Liquid-rich 2-phase	213			
	309-1-6.3	quartz	5	irregular	Liquid-rich 2-phase	192			
K9030309	309-1-6.4	quartz	5	irregular	Liquid-rich 2-phase	198			

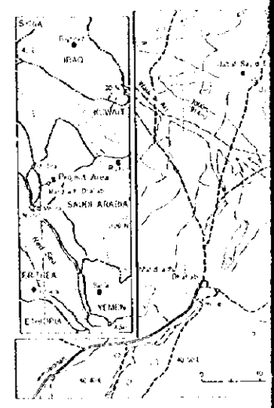
Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
	309-1-6.5	quartz	6	irregular	Liquid-rich 2-phase	196			Homogenized into a single liquid phase. Too small to measure salinity.
	309-1-6.6	quartz	7	irregular	Liquid-rich 2-phase	219			
	309-1-6.7	quartz	4	irregular	Liquid-rich 2-phase	185			
	309-1-6.8	quartz	3	irregular	Liquid-rich 2-phase	174			
	309-1-6.9	quartz	3	irregular	Liquid-rich 2-phase	174			
	309-1-7.1	quartz	5	irregular	Liquid-rich 2-phase	198			
	309-1-7.2	quartz	4	irregular	Liquid-rich 2-phase	177			
	309-1-7.3	quartz	4	irregular	Liquid-rich 2-phase	233			
					(Average of Homo. Temp.)	198	(Average of salinity)	0.2	
					(STDEV of Homo. Temp.)	19.0	(STDEV of salinity)	0.2	
K9030308	308-1	quartz	15	irregular	Liquid-rich 2-phase	183	0.5	0.8	Homogenized into a single liquid phase.
	308-2	quartz	20	irregular	Liquid-rich 2-phase	181	0.4	0.6	
	308-3	quartz	10	irregular	Liquid-rich 2-phase	147			
	308-4	quartz	20	irregular	Liquid-rich 2-phase	276	0.5	0.8	
	308-5	quartz	10	irregular	Liquid-rich 2-phase	275	0.6	1	
	308-6	quartz	10	irregular	Liquid-rich 2-phase	154	0.6	1	
	308-7	quartz	20	irregular	Liquid-rich 2-phase	203	0.5	0.8	
	308-8	quartz	20	irregular	Liquid-rich 2-phase	196	0.5	0.8	
	308-9	quartz	10	irregular	Liquid-rich 2-phase	233	0.6	1	
	308-10	quartz	10	irregular	Liquid-rich 2-phase	235	0.7	1.2	
	308-11	quartz	15	irregular	Liquid-rich 2-phase	275	0.6	1	
	308-12	quartz	10	irregular	Liquid-rich 2-phase	202	0.6	1	
	308-13	quartz	10	irregular	Liquid-rich 2-phase	276	0.7	1.2	
	308-14	quartz	10	irregular	Liquid-rich 2-phase	272	0.7	1.2	
	308-15	quartz	15	irregular	Liquid-rich 2-phase	210	0.6	1	
					(Average of Homo. Temp.)	221	(Average of salinity)	0.9	

Sample No.	Inclusion No.	Minerals	Size (major axis, mm)	Shape	Kind of inclusions	Homogenization temperature(℃)	Temperature of melting point of ice (below 0℃)	Salinity (NaCl wt %)	Remarks
					(STDEV of Homo. Temp.)	46.0	(STDEV of salinity)	0.2	
K9030307	307-1	quartz	10	irregular	Liquid-rich 2-phase	264			Homogenized into a single liquid phase.
	307-2	quartz	7	irregular	Liquid-rich 2-phase	308			
	307-3	quartz	10	elliptical	Liquid-rich 2-phase	309			
	307-4	quartz	5	irregular	Liquid-rich 2-phase	309			
	307-5	quartz	7	irregular	Liquid-rich 2-phase	228	5.0	7.9	
	307-6	quartz	5	irregular	Liquid-rich 2-phase	216	4.5	7.1	
	307-7	quartz	20	irregular	Liquid-rich 2-phase	282	7.3	10.9	
	307-8	quartz	15	irregular	Liquid-rich 2-phase	300	5.7	8.8	
	307-9	quartz	4	irregular	Liquid-rich 2-phase	228			
	307-10	quartz	15	irregular	Liquid-rich 2-phase	224			
	307-11	quartz	6	irregular	Liquid-rich 2-phase	111			
	307-12	quartz	2	elliptical	Liquid-rich 2-phase	189			
	307-13	quartz	13	irregular	Liquid-rich 2-phase	290	4.2	6.7	
	307-14	quartz	10	irregular	Liquid-rich 2-phase	293			
	307-15	quartz	12	irregular	Liquid-rich 2-phase	294			
	307-16	quartz	10	irregular	Liquid-rich 2-phase	265			
	307-17	quartz	4	irregular	Liquid-rich 2-phase	261			
	307-18	quartz	18	irregular	Liquid-rich 2-phase	262			
	307-19	quartz	10	irregular	Liquid-rich 2-phase	256			
	307-20	quartz	9	irregular	Liquid-rich 2-phase	257			
	307-21	quartz	7	elliptical	Liquid-rich 2-phase	283			
	307-22	quartz	5	elliptical	Liquid-rich 2-phase	285			
					(Average of Homo. Temp.)	260	(Average of salinity)	8.3	
					(STDEV of Homo. Temp.)	47.0	(STDEV of salinity)	1.7	
K9030301	301-1	quartz	10	elliptical	Liquid-rich 2-phase	>430	3.7	6	Necking down?

Umm ad Damar Area

REPORT ON THE COOPERATIVE MINERAL
IN THE UMM AD DAMAR ARE
THE KINGDOM OF SAUDI ARA
PHASE I

GEOLOGICAL MAP OF THE SURVEY A



MARCH 1909

JAPAN INTERNATIONAL COOPERATION
METAL MINING AGENCY OF J

AGE		SEDIMENTARY AND VOLCANIC ROCKS
CENOZOIC	QUATERNARY	Q sand, gravel
LATE PROTEROZOIC	MAHD GROUP (Haf Formation)	Ha andesite, andesitic volcaniclastic rocks, conglomerate
		BARI GRANODIORITE HUFAYRIYA TONALITE
	ARJ GROUP (Jabal Aslam & Sayid Formations)	Aa andesite, andesitic volcaniclastic rocks
		Ad dacite, dacitic volcaniclastic rocks
		Ar rhyodacite, rhyodacitic volcaniclastic rocks
		Aj jasper

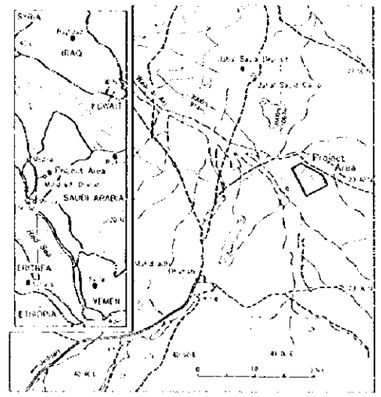
--- Fault

ar Area

PL. 1

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

GEOLOGICAL MAP OF THE SURVEY AREA (1:10,000)



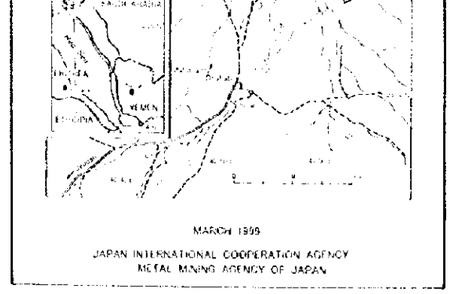
MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

AGE		SEDIMENTARY AND VOLCANIC ROCKS	INTRUSIVE ROCKS
CENOZOIC	QUATERNARY	Q sand, gravel	
LATE PROTEROZOIC	MAHD GROUP (Haf Formation)	Ha andesite, andesitic volcaniclastic rocks, conglomerate	
	BARI GRANODIORITE, HUFAYRIYA TONALITE		T tonalite
			D quartz diorite, diorite
			b basalt
			a andesite
			d dacite
			r rhyodacite
	ARJ GROUP (Jabal Aslam & Sayid Formations)	Aa andesite, andesitic volcaniclastic rocks	
		Ad dacite, dacitic volcaniclastic rocks	
		Ar rhyodacite, rhyodacitic volcaniclastic rocks	
		Ja jasper	

Fault

Umm ad Damar North
Umm ad Damar South
4.6 Gossan
(silicified)
(silicified)
(silicified)
waste dump
A
A'
B
B'
C
C'
MARCH 1999
JAPAN INTERNATIONAL COOPERATION AG
METAL MINING AGENCY OF JAPA
AGE
SEDIMENTARY AND VOLCANIC ROCKS
CENOZOIC
QUATERNARY
Q sand, gravel
MAHD GROUP (Hal Foramtion)
Ha andesite, andesitic volcaniclastic rocks, conglomerate
LATE PROTEROZOIC
BARI GRANODIORITE, HUFAYRIYA TONALITE
ARJ GROUP (Jabal Azlam & Sayid Formations)
Aa andesite, andesitic volcaniclastic rocks
Ad dacite, dacitic volcaniclastic rocks
Ar rhyodacite, rhyodacitic volcaniclastic rocks
Aj jasper
Fault
1:10,000

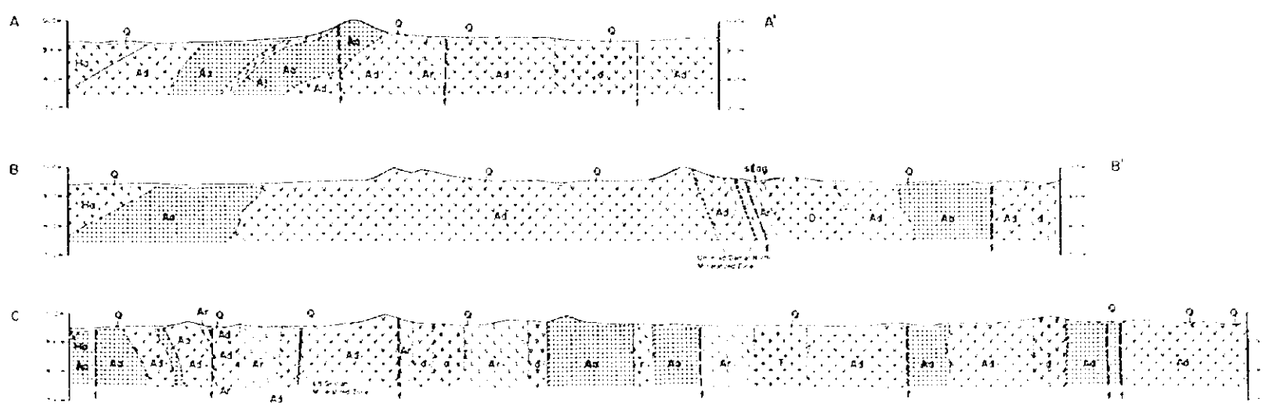


MARCH 1999

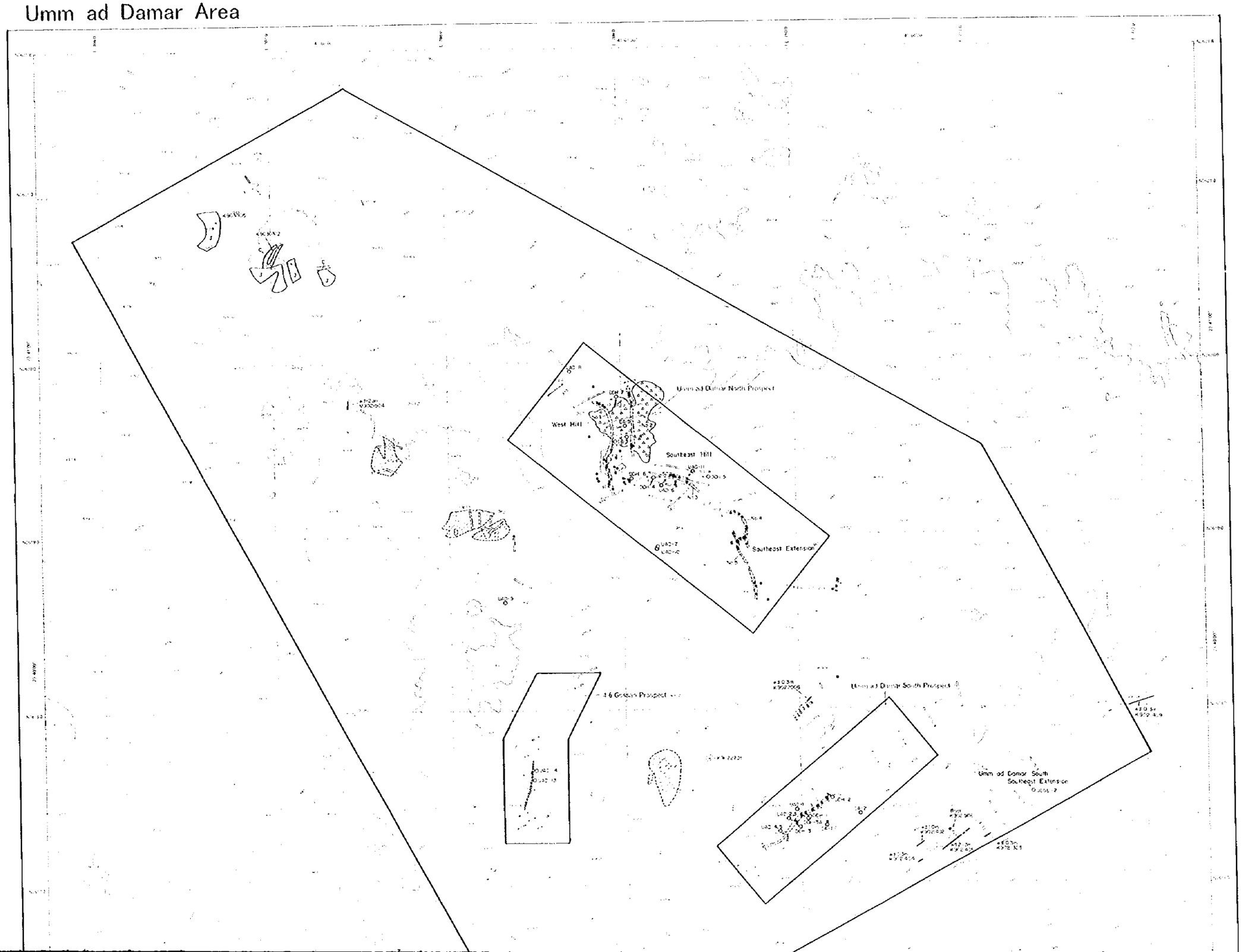
JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

AGE	SEDIMENTARY AND VOLCANIC ROCKS	INTRUSIVE ROCKS
CENOZOIC QUATERNARY	[Q] sand, gravel	
LATE PROTEROZOIC	MAHD GROUP (Hal Formation) [Ha] andesite, andesitic volcaniclastic rocks, conglomerate	
		BARI GRANODIORITE, HUFAYRIYA TONALITE: [T] tonalite; [D] quartz diorite, diorite; [b] basalt; [a] andesite; [d] dacite; [r] rhyodacite
	ARJ GROUP (Jabal Azlam & Sayid Formations) [Aa] andesite, andesitic volcaniclastic rocks; [Ad] dacite, dacitic volcaniclastic rocks; [Ar] rhyodacite, rhyodacitic volcaniclastic rocks; [Aj] jasper	

Fault

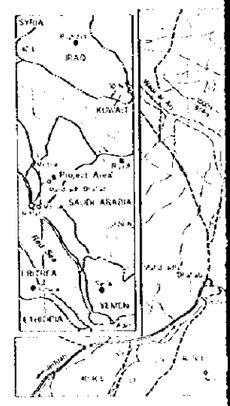


Umm ad Damar Area



REPORT ON THE COOPERATIVE
IN THE UMM AD DA
THE KINGDOM OF SA
PHASE

MINERALIZATION MAP OF THE

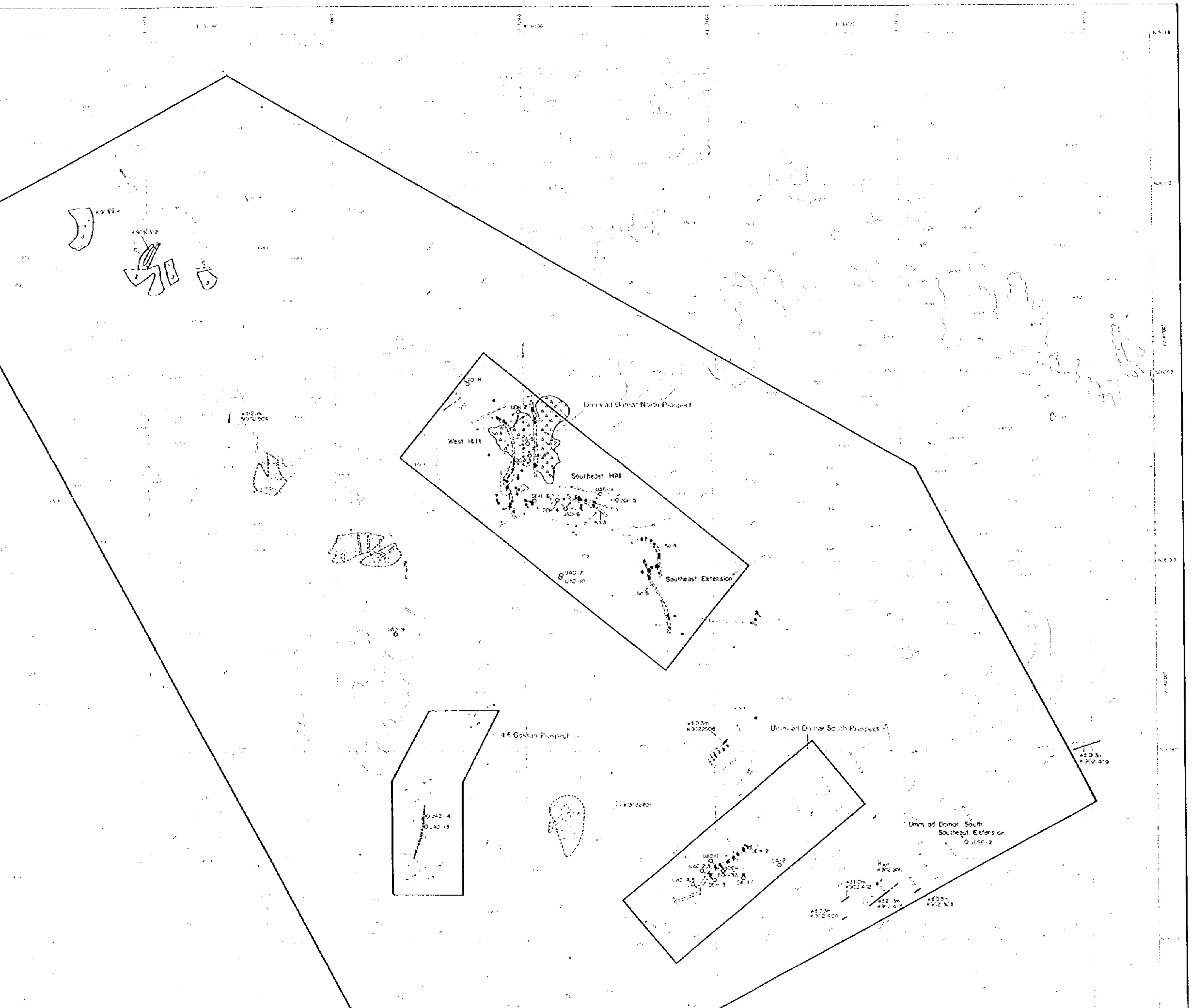


MARCH 19
JAPAN INTERNATIONAL COOP
METAL MINING AGEN

LEGEND

- Arj Group jasper
- stag
- Carbonatization
- Silicification
- Epidotization & s
- Mineralized zone
- Drill hole
- Ancient working
- Quartz vein
- Trench

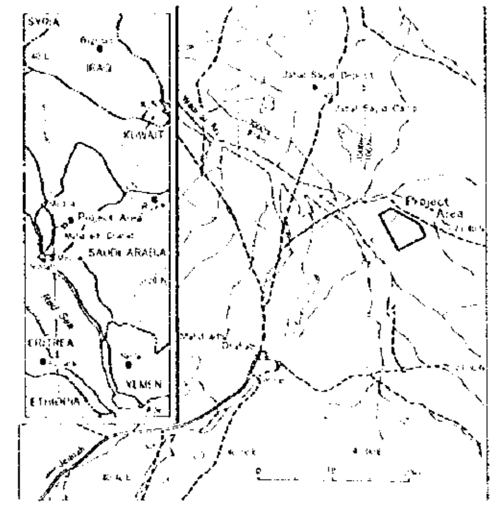
...amar Area



PL 2

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

MINERALIZATION MAP OF THE SURVEY AREA (1:10,000)

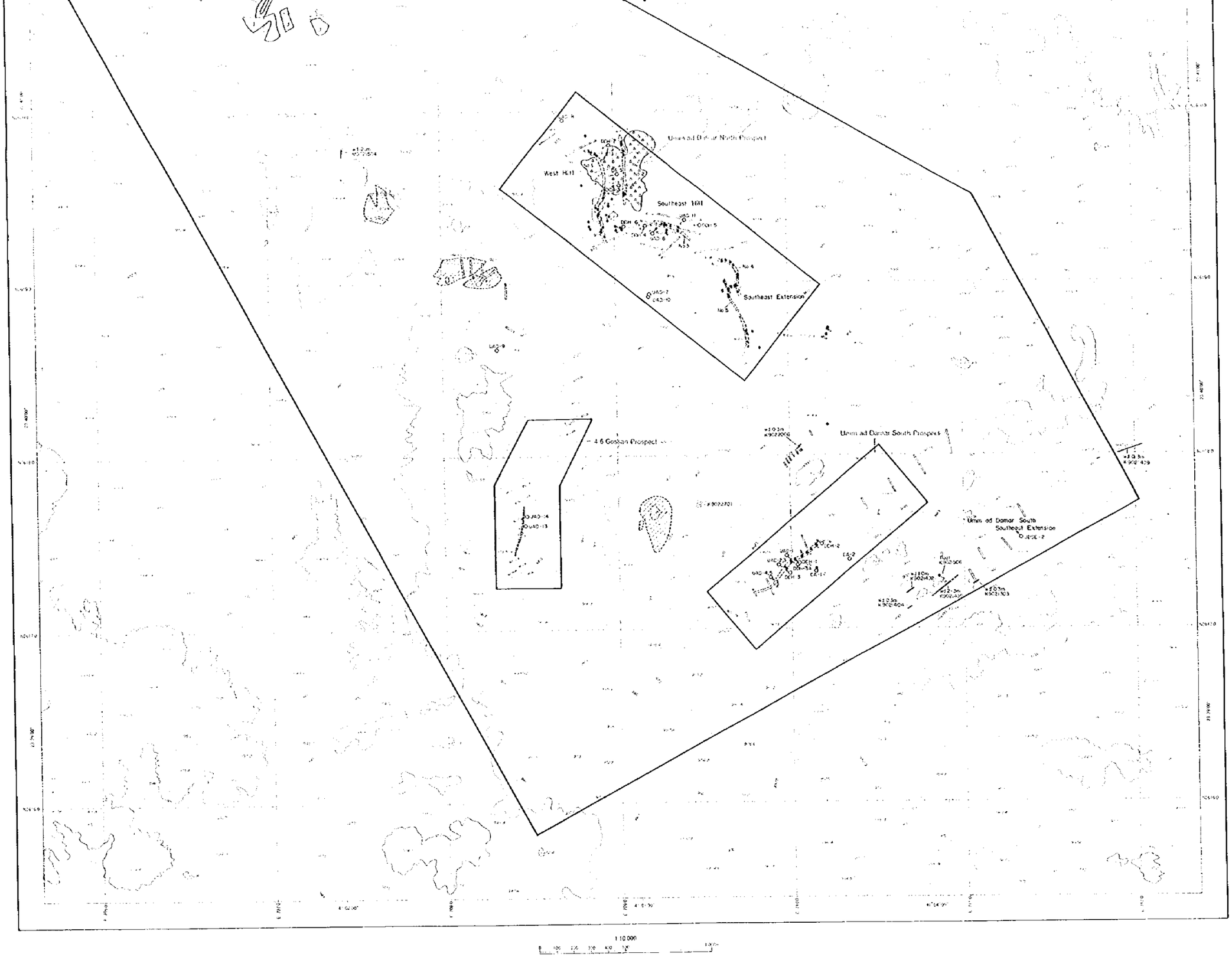


MARCH 1990

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

- Arj Group jasper
- slag
- Carbonatization
- Silicification
- Epidotization & weak Silicification
- Mineralized zone
- Drill hole
- Ancient working
- Quartz vein
- Trench

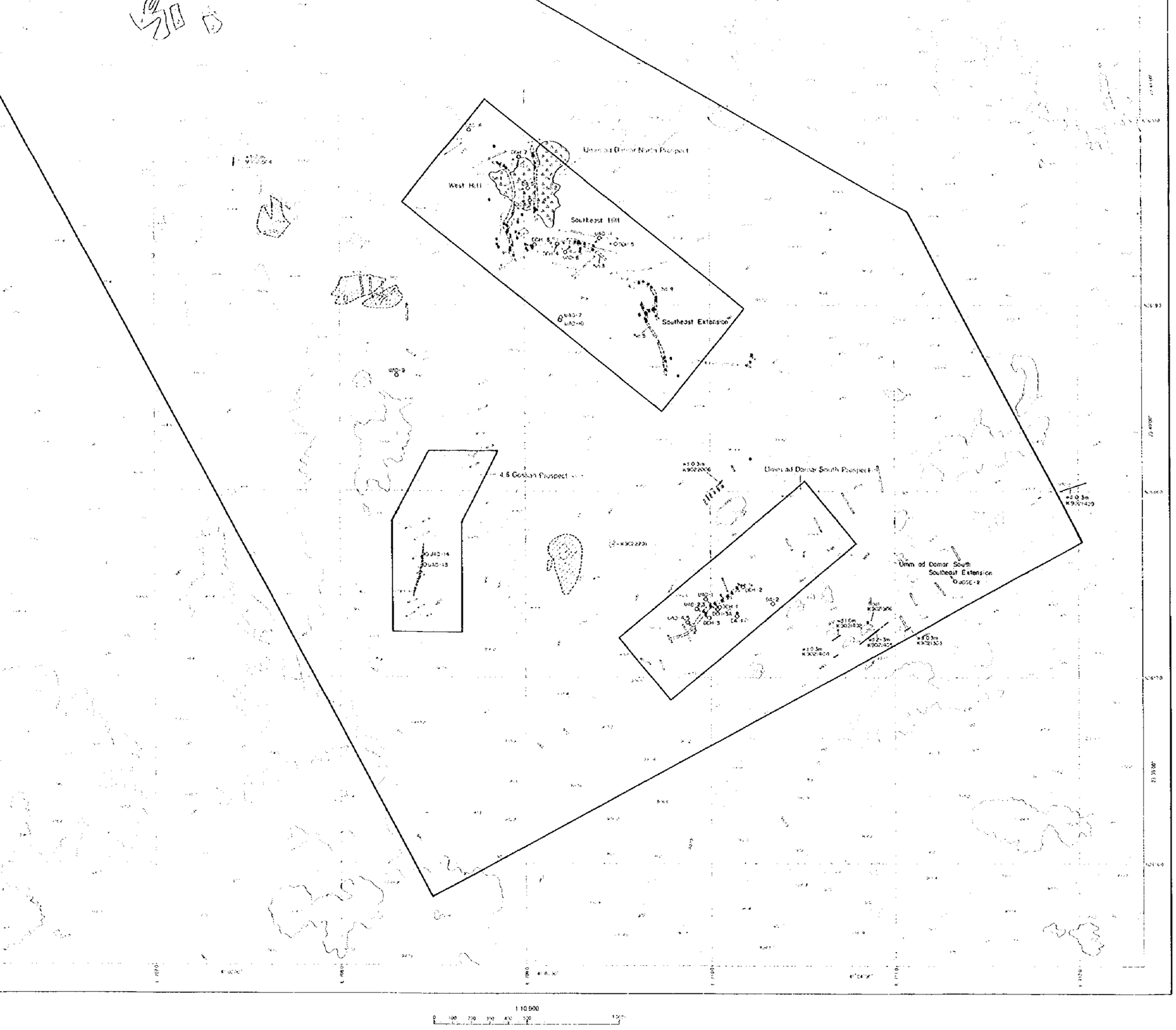


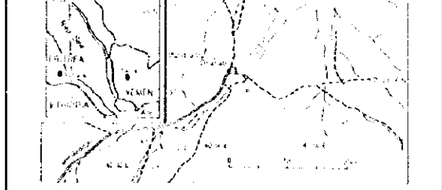
MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

- Acj Group jasper
- slag
- Carbonatization
- Silicification
- Epidotization & weak Silicification
- Mineralized zone
- Drill hole
- Ancient working
- Quartz vein
- Trench



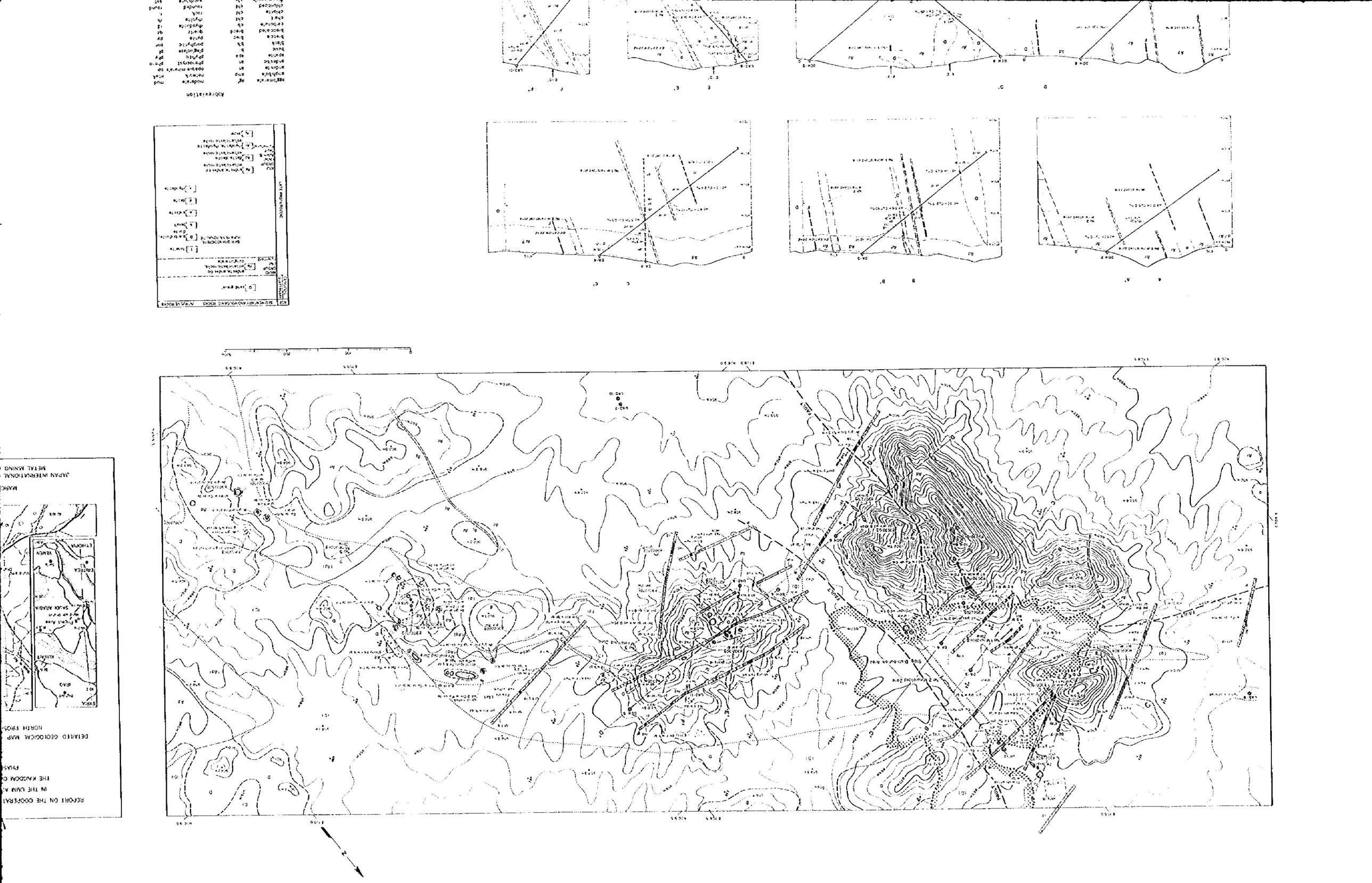


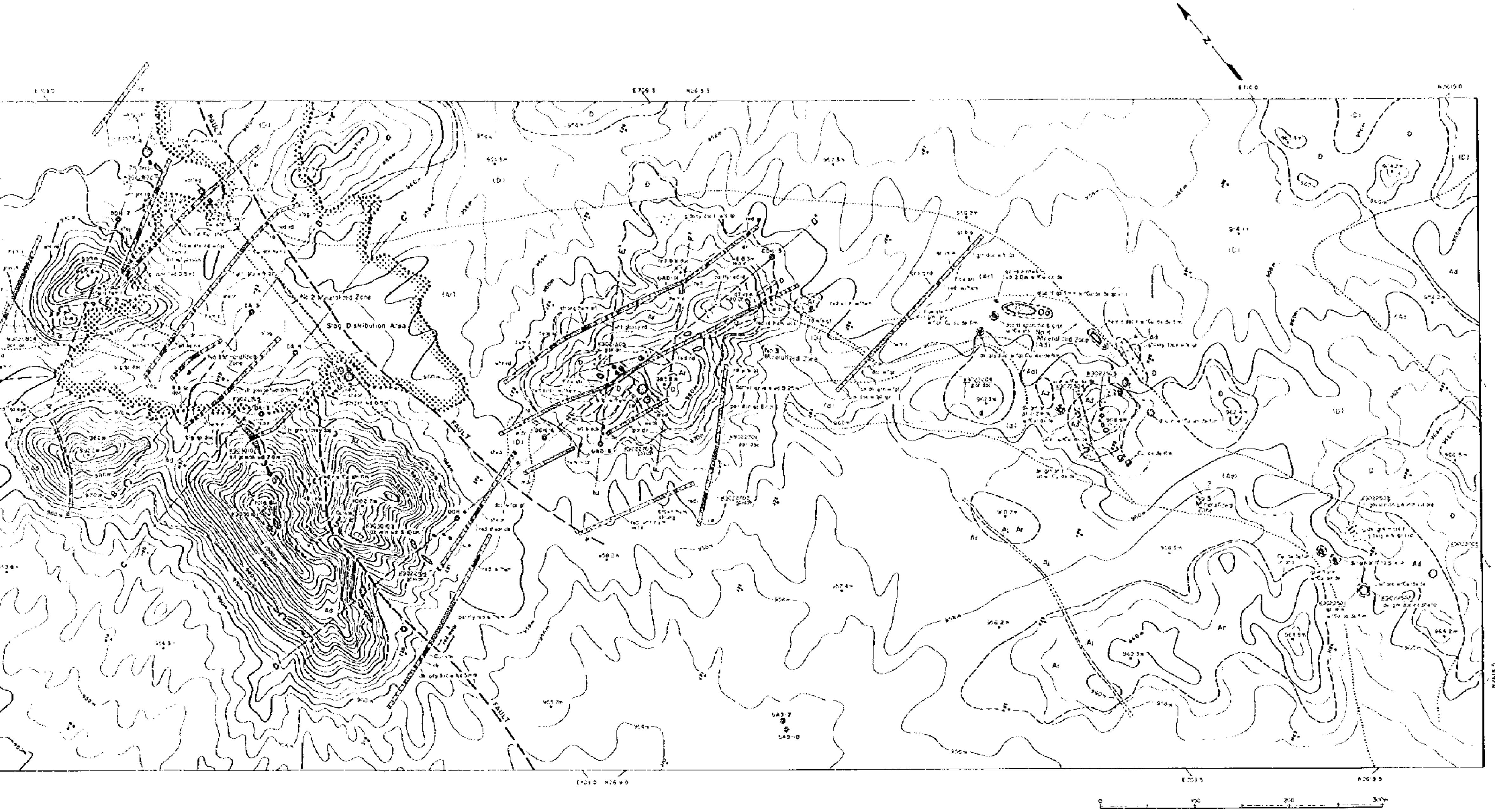
MARCH 1989

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

- Adj Group jasper
- slag
- Carbonatization
- Silicification
- Epidotization & weak Silicification
- Mineralized zone
- Drill hole
- Ancient working
- Quartz vein
- Trench

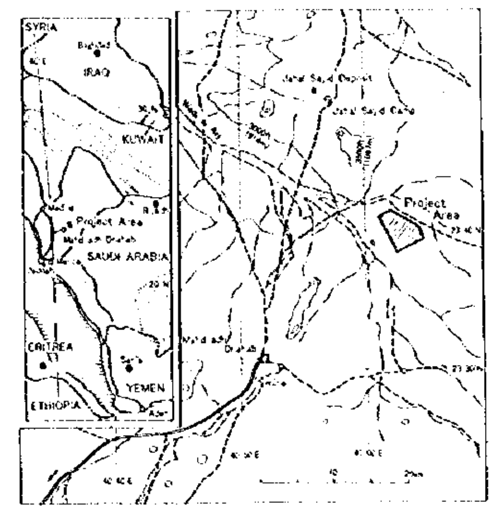




PL. 3

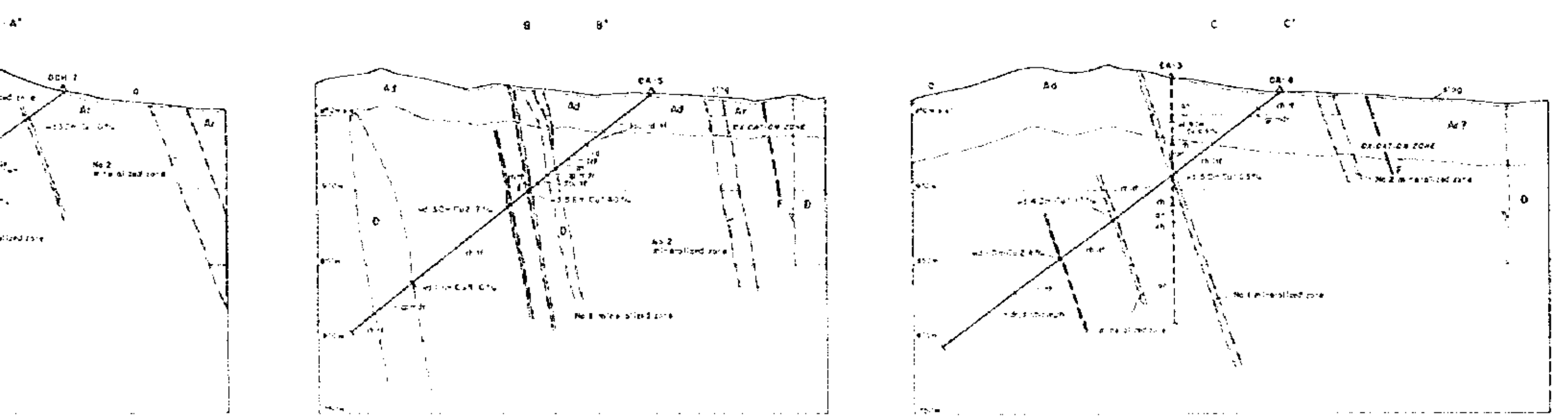
REPORT ON THE COOPERATIVE MINERAL EXPLORATION IN THE UMM AD DAMAR AREA THE KINGDOM OF SAUDI ARABIA PHASE Ⅰ

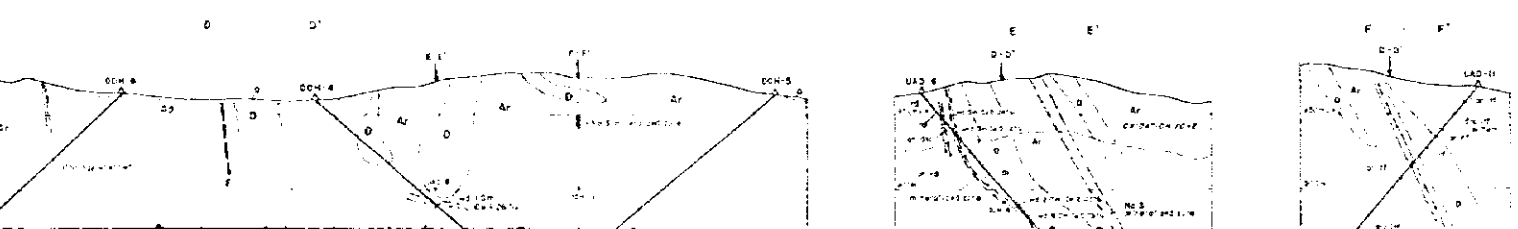
DETAILED GEOLOGICAL MAP OF THE UMM AD DAMAR NORTH PROSPECT (1:2,500)



MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

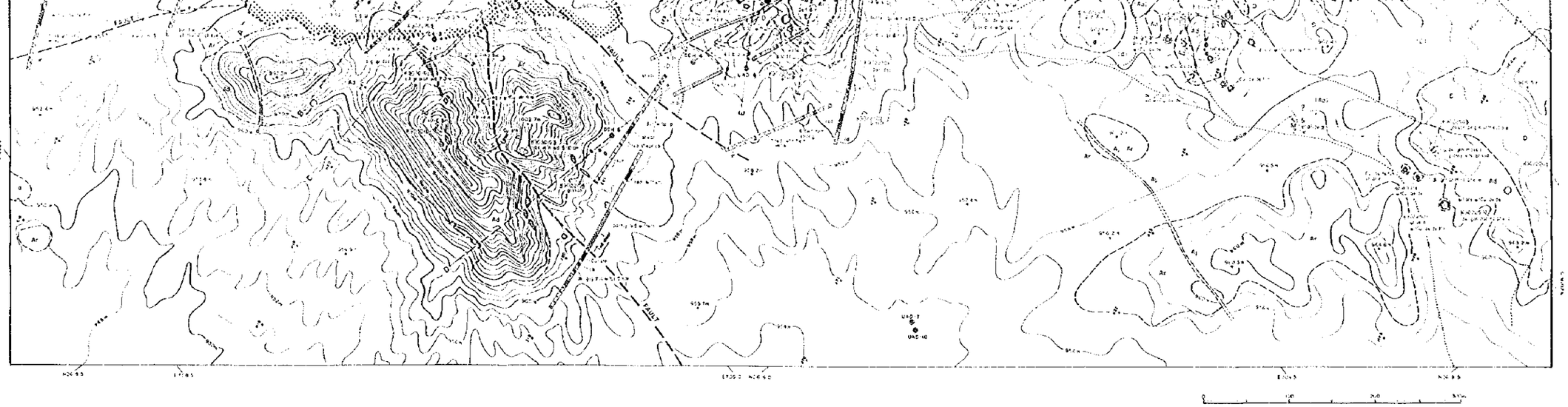


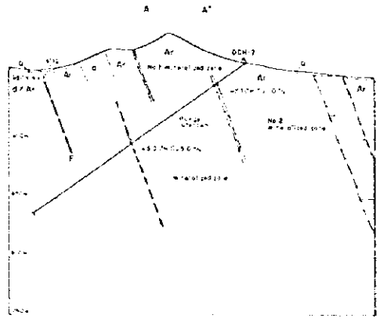


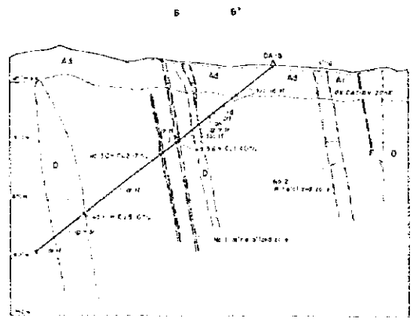
AGE		SEDIMENTARY AND VOLCANIC ROCKS	INTRUSIVE ROCKS
CENOZOIC QUATERNARY		[Q] sand, gravel	
LATE PROTEROZOIC	MAHD GROUP (Hail Formation)	[Mh] andesite, andesitic volcaniclastic rocks, conglomerate	
	BAF GRANODIORITE, NUFAYRIYAH TONALITE		[t] tonalite
			[D] quartz diorite, diorite
			[b] basalt
			[a] andesite
			[d] dacite
			[r] rhyodacite
	ARJ GROUP (Hamdah & Ghamr Formation)	[Aa] andesite, andesitic volcaniclastic rocks	
		[Ad] dacite, dacitic volcaniclastic rocks	
		[Ar] rhyodacite, rhyodacitic volcaniclastic rocks	
		[Aj] jasper	

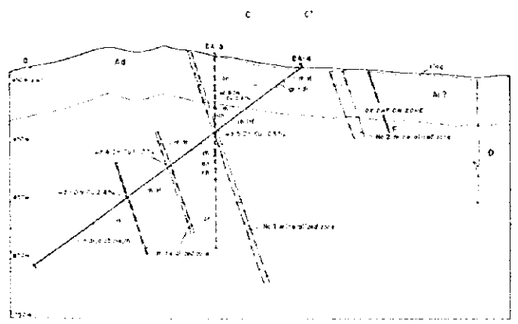
Abbreviation

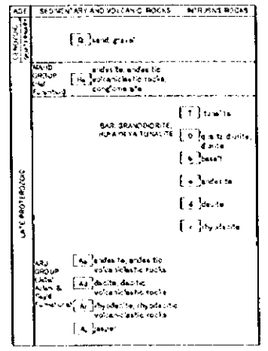
agglomerate	agl	moderate	mod
amphibole	amp	network	ntwk
andesite	an	opaque minerals	op
andesitic	an	phenocryst	pheno
apatite	apa	phyllitic	phy
basic	b	plagioclase	pl
black	blk	porphyritic	por
breccia	brec	pyrite	py
brecciated	brecd	quartz	qz
carbonate	cb	rhyodacite	rd
chert	cht	rhyolite	rh
chlorite	chl	rock	r

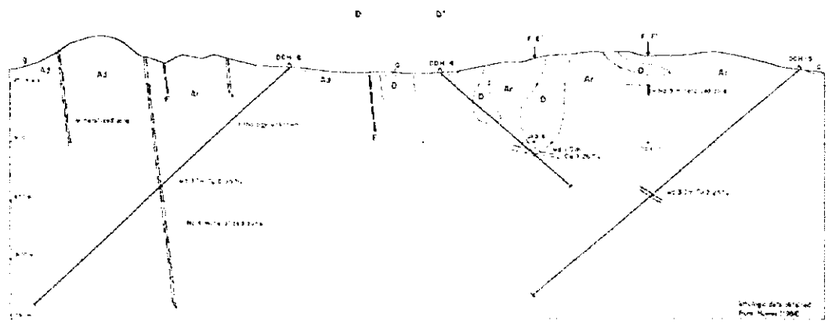


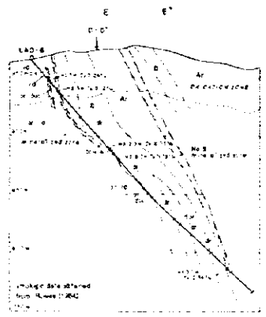






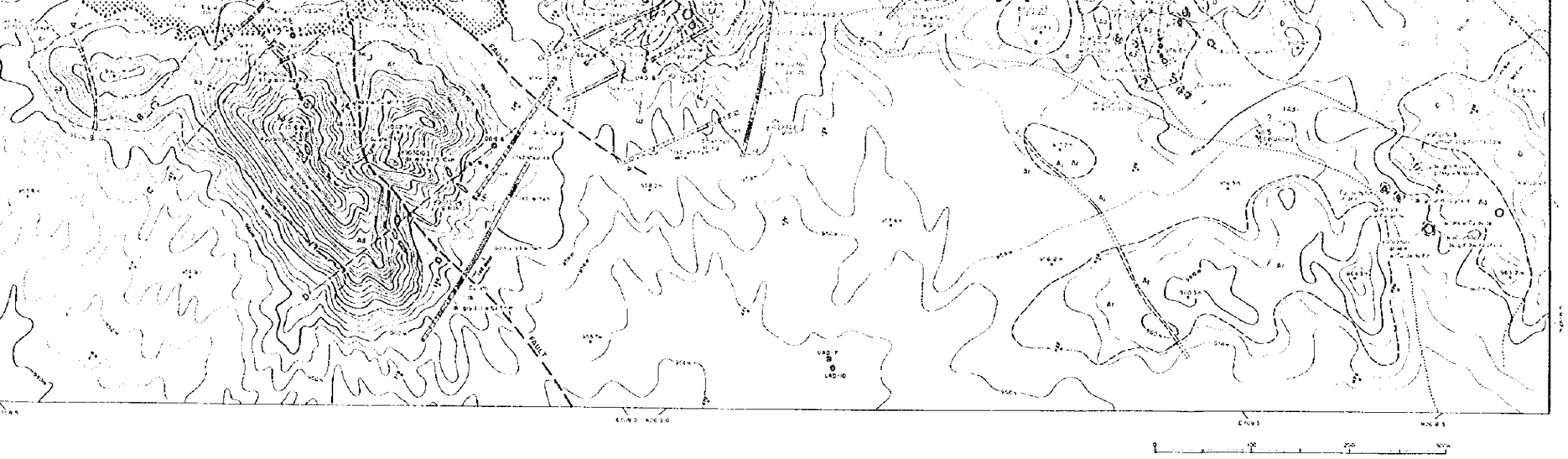


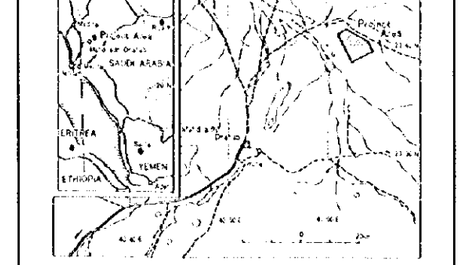




Abbreviation

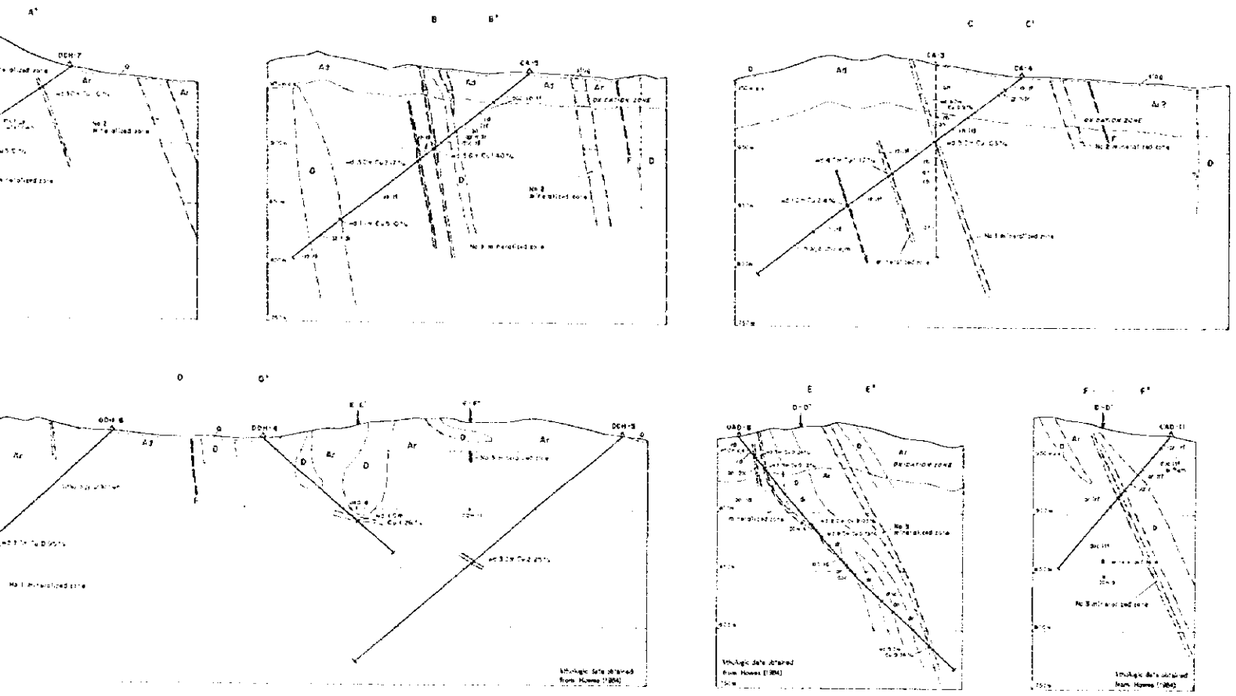
agglomerate	agl	moderate	mod
amphibole	amp	network	ntwk
andesite	an	opaque minerals	op
andesitic	an	phenocryst	pheno
apatite	apa	phyllitic	phy
basic	b	plagioclase	pl
black	blk	porphyritic	por
breccia	brec	pyrite	py
brecciated	brecd	quartz	qz
carbonate	cb	rhyodacite	rd
chert	cht	rhyolite	rh
chlorite	chl	rock	r
chloritized	chl	rounded	round
clay minerals	cly	sandstone	sst
clinopyroxene	cpx	schist	sch
dacite	dac	sericite	ser
dark	dk	shale	sh
diorite	di	sheared	shear
disseminated	diss	siliceous	sil
dotted	dott	silicified	silic
epidote	epi	spotted	spot
film	film	stain	stn
gravel	gr	structure	str
gray	gry	sulfide	sul
green	grn	tilanite	ti
hematite	hem	tonalite	to
hornblende	hb	tuff	tf
intrusive	int	veinlet	vnlt
K-feldspar	kf	weakly	wkly
lapilli tuff	ltf	white	wht
light	lt	width	wd
massive	mass	with	w/
microdiorite	mdi		

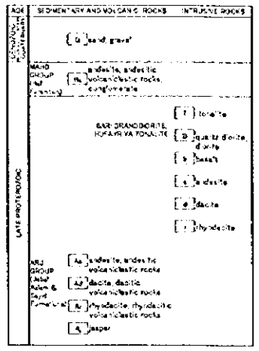




MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN





Abbreviation

agglomerate	agl	moderate	mod
amphibole	amp	network	ntwk
andesite	an	opaque mineral's	op
andesitic	an	phenocryst	pheno
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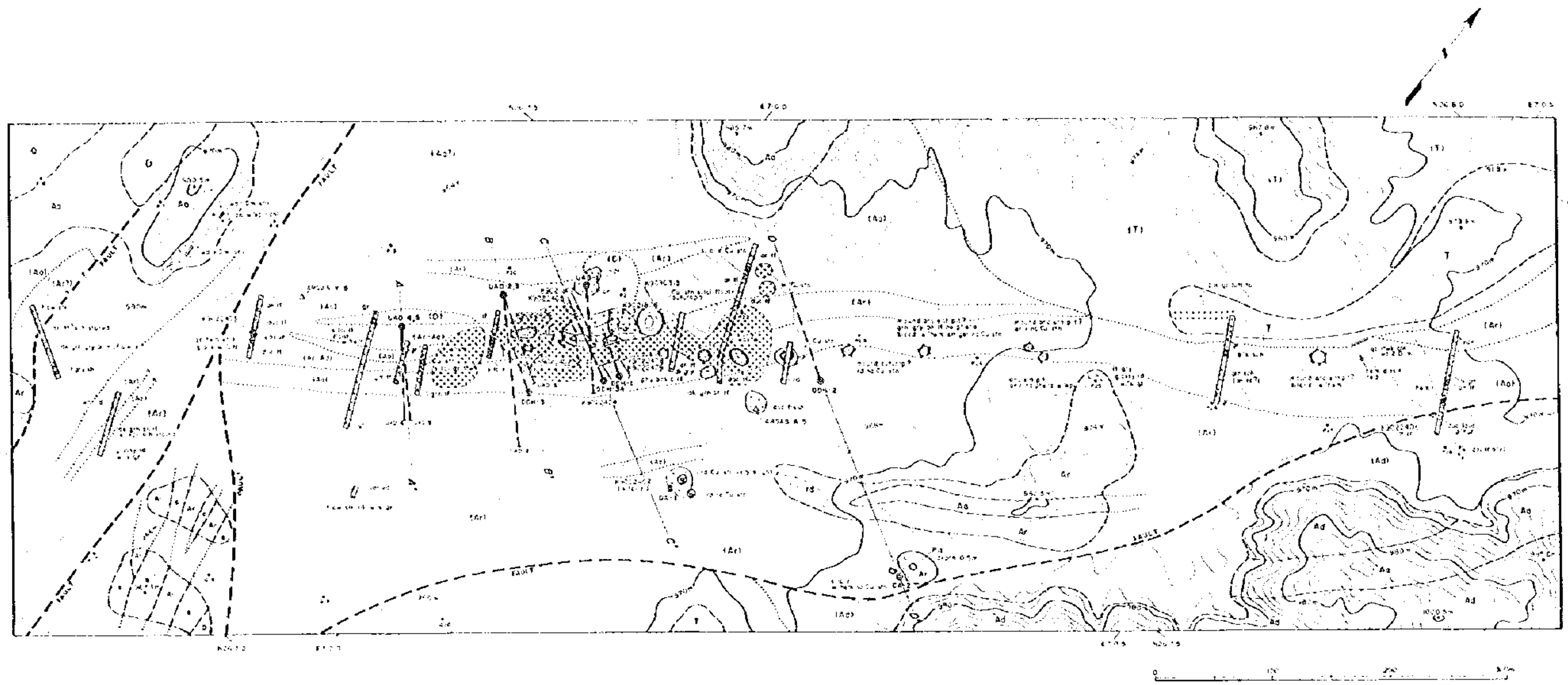
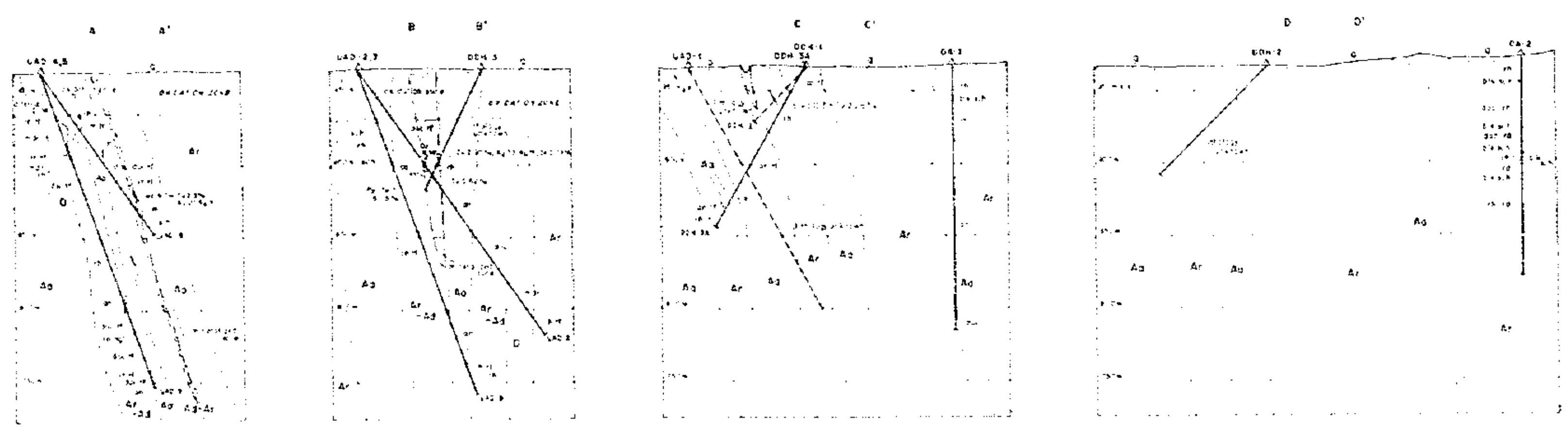
basic	b	plagioclase	pl
black	blk	porphyritic	por
breccia	brec	pyrite	py
brecciated	brecd	quartz	qz
carbonate	cb	rhyodacite	rd
chert	cht	rhyolite	rh
chlorite	chl	rock	r.
chloritized	chl	rounded	round
clay mineral's	cly	sandstone	sst
clinopyroxene	cpx	schist	sch
dacite	dac	sericite	ser
dark	dk	shale	sh
diorite	dr	sheared	shear
disseminated	diss	siliceous	sil
dotted	dott	silicified	silic
epidote	epi	spotted	spot
film	film	stain	stn
gravel	gr	structure	str
gray	gry	sulfide	sul
green	grn	tonalite	to
hematite	hem	tuff	tf
hornblende	hb	vein/let	vn/lt
intrusive	int	weakly	wkly
K-fe'dspar	kf	white	wht
lapilli tuff	ltf	width	wd
light	lt	with	w/
massive	mass		
microdiorite	mdr		

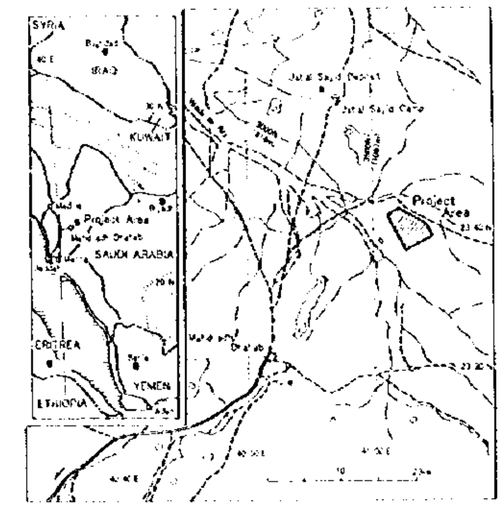




PL. 4

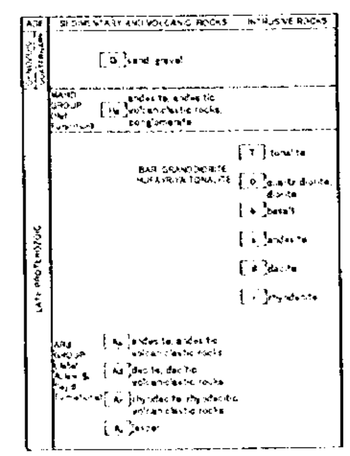
REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

DETAILED GEOLOGICAL MAP OF THE UMM AD DAMAR
SOUTH PROSPECT (1:2500)



MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN



Abbreviation

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andesitic	an	phenocryst	pheno
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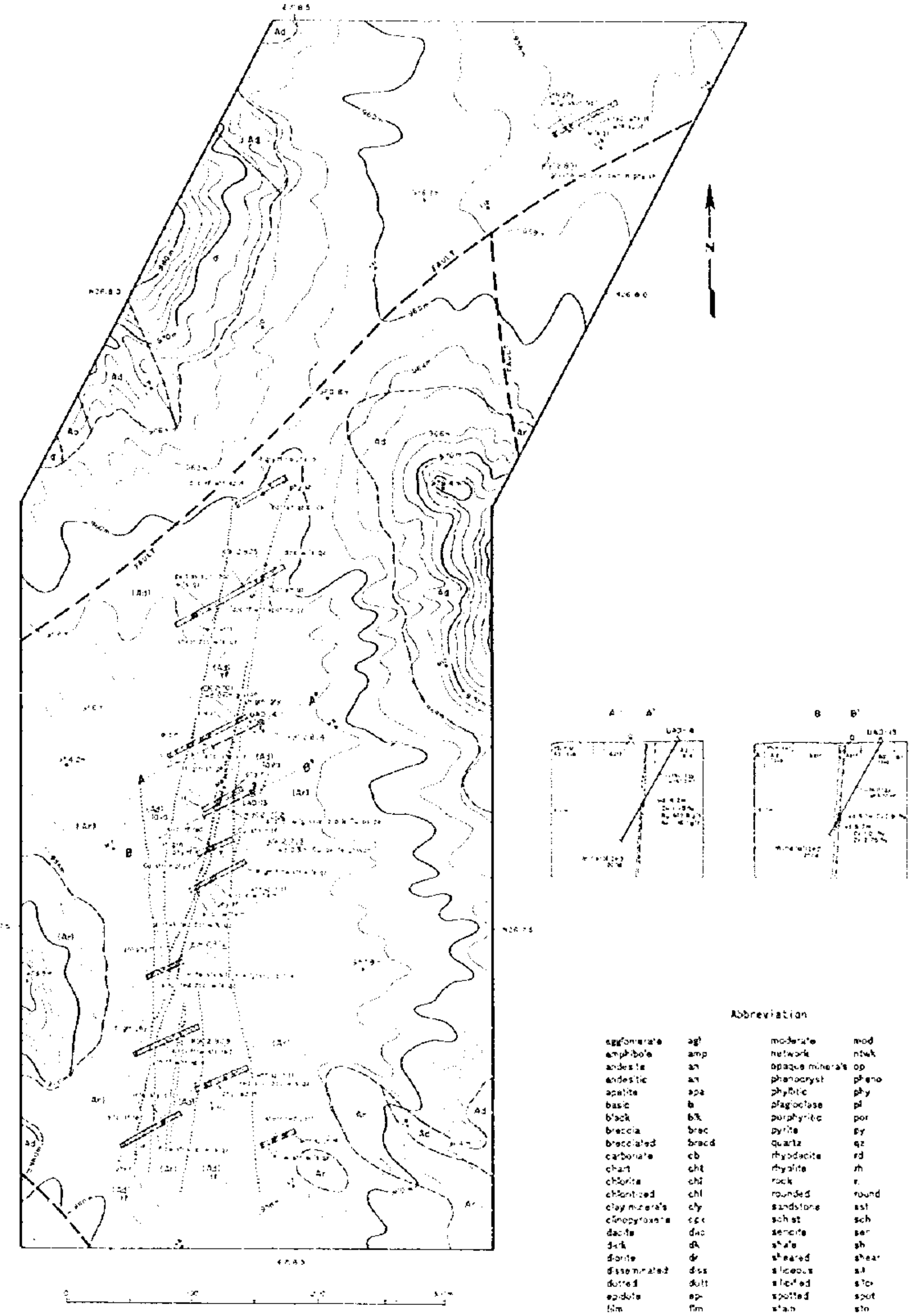
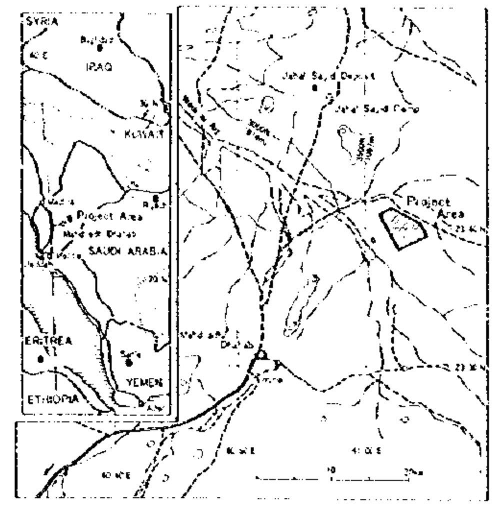
brecciated	brecd	quartz	qz
carbonate	cb	rhyodacite	rd
chert	cht	rhyolite	rh
chlorite	chl	rock	r
chloritized	chl	rounded	round
clay minerals	cly	sandstone	sst
clinopyroxene	cpx	schist	sch
dacite	dac	sericite	ser
dark	dk	shale	sh
diorite	dr	sheared	shear
disseminated	diss	siliceous	sil
dotted	dott	silicified	silcf
epidote	ep	spotted	spot
film	flm	stain	stn
gravel	gr	structure	str
gray	gry	sulfide	sul
green	grn	titanite	tit
hematite	hem	tonalite	to
hornblende	hb	tuff	tf
intrusive	int	veinlet	vnlt
K-feldspar	kf	weakly	wkly
lapilli tuff	ltf	white	wht
light	lt	width	wd
massive	mass	with	w/
microdiorite	mdr		



PL 5

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

DETAILED GEOLOGICAL MAP OF THE 4/6 GOSSAN PROSPECT (1:2,500)



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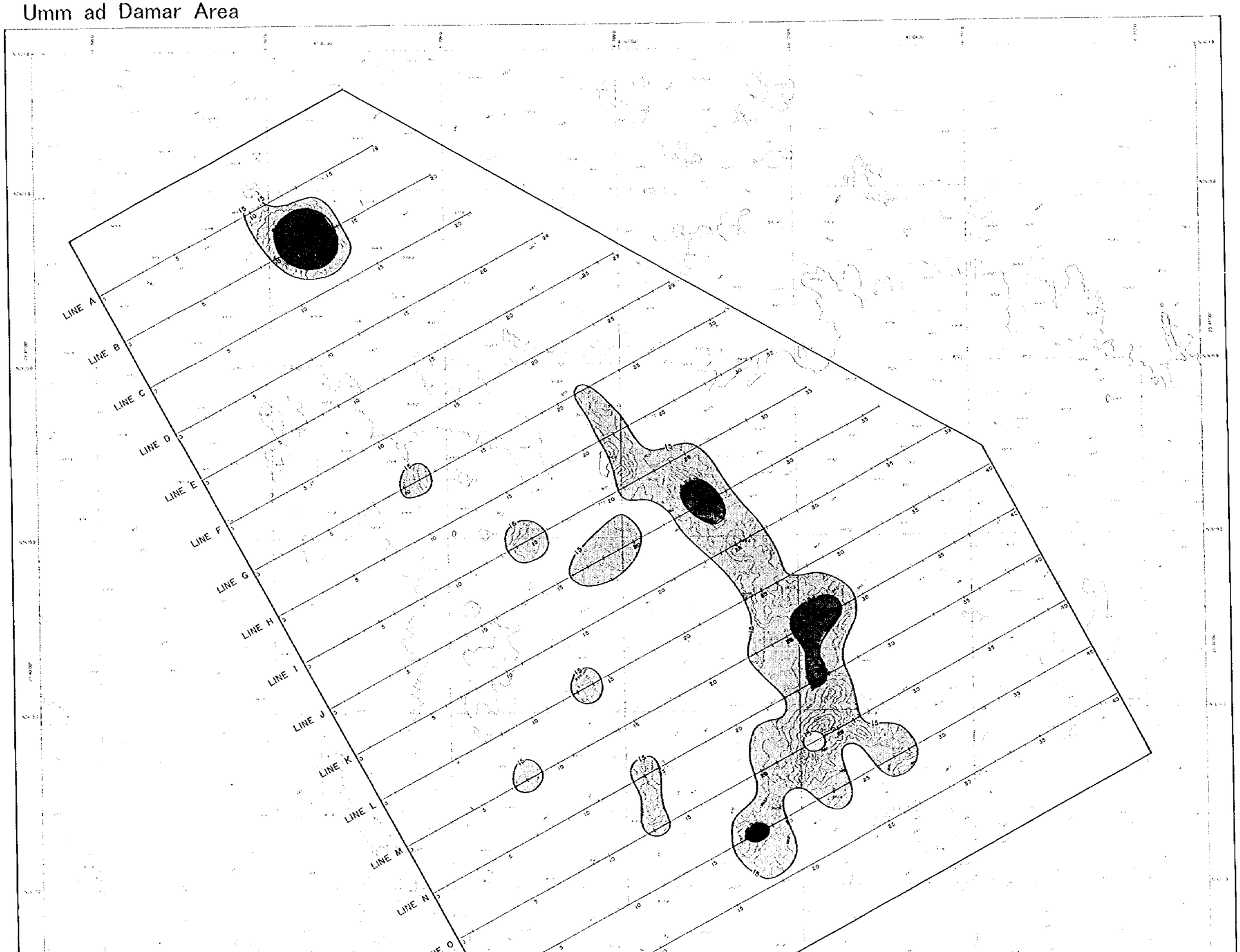
JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

AGE	SEDIMENTARY AND VOLCANIC ROCKS	INTRUSIVE ROCKS
CENOZOIC QUATERNARY	Q sand, gravel	
LATE PROTEROZOIC, NAHD GROUP	Ha andesite, andesitic volcaniclastic rocks, conglomerate	
BAR GRANODIORITE, NUFAYRIYA TONALITE		T tonalite
		D quartz diorite, diorite
		b basalt
		a andesite
		d dacite
		r rhyodacite
ARJ GROUP	Aa andesite, andesitic volcaniclastic rocks	
	Ad dacite, dacitic volcaniclastic rocks	
	Ar rhyodacite, rhyodacitic volcaniclastic rocks	
	Aj jasper	

Abbreviation

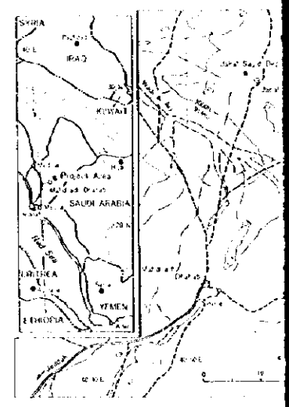
agglomerate	agl	moderate	mod
amphibole	amp	network	ntwk
andesite	an	opaque minerals	op
andesitic	an	phenocryst	pheno
apatite	apa	phyllitic	phy
basic	b	plagioclase	pl
black	blk	porphyritic	por
breccia	brec	pyrite	py
brecciated	brecd	quartz	qz
carbonate	cb	rhyodacite	rd
chert	cht	rhyolite	rh
chlorite	chl	rock	r
chloritized	chl	rounded	round
clay minerals	cly	sandstone	sst
clinopyroxene	cpx	schist	sch
dacite	dac	sericite	ser
dark	dk	shale	sh
diorite	dr	sheared	shear
disseminated	diss	siliceous	sil
dotted	dott	silicified	silci
epidote	ep	spotted	spot
film	flm	stain	stn
gravel	gr	structure	str
gray	gry	sulfide	sul
green	grn	titanite	tit
hematite	hem	tonalite	to
hornblende	hb	tuff	tf
intrusive	int	veinlet	vnlt
K-feldspar	kf	weakly	wkly
lapilli tuff	lpt	white	wht
light	lt	width	wd
massive	mass	with	w/
microdiorite	mdr		

Umm ad Damar Area



REPORT ON THE COOPERATIVE MINERAL E
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABI
PHASE I

GEOPHYSICAL ANOMALY MAP OF THE SURVE



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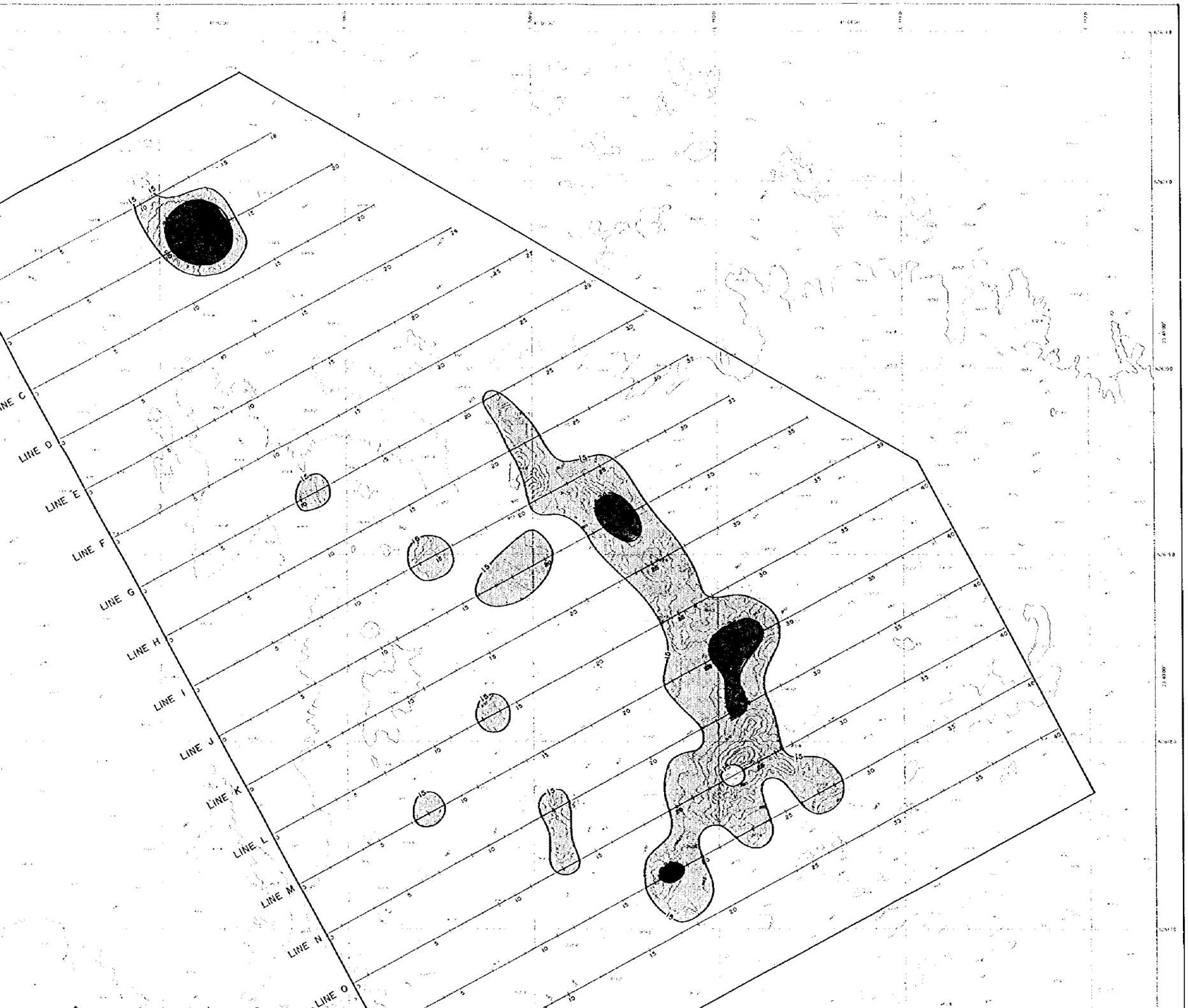
JAPAN INTERNATIONAL COOPERATION A
METAL MINING AGENCY OF JAP

LEGEND

Chargeability
- Mx ≥ 24 mV/V
- 15 ≤ Mx ≤ 24 mV/V

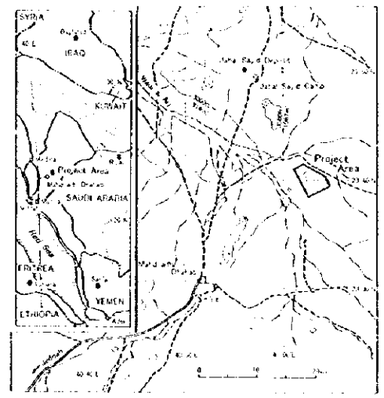
Damar Area



PL 6

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

GEOPHYSICAL ANOMALY MAP OF THE SURVEY AREA (1:10,000)



MARCH 1999

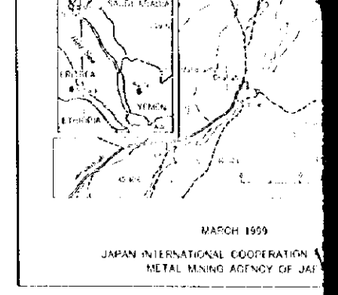
JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

Chargeability
- Mx ≥ 24 mV/V
- 15 ≤ Mx ≤ 24 mV/V

LINE A
LINE B
LINE C
LINE D
LINE E
LINE F
LINE G
LINE H
LINE I
LINE J
LINE K
LINE L
LINE M
LINE N
LINE O
LINE P
LINE Q

1:10000



MARCH 1989

JAPAN INTERNATIONAL COOPERATION
METAL MINING AGENCY OF JAP

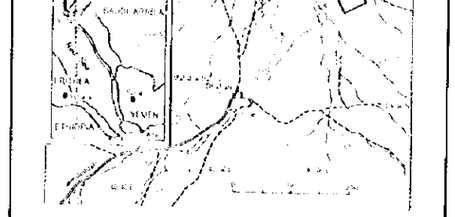
LEGEND

Chargeability

Mx ≥ 24 mV/V

15 ≤ Mx ≤ 24 mV/V

LINE B
LINE C
LINE D
LINE E
LINE F
LINE G
LINE H
LINE I
LINE J
LINE K
LINE L
LINE M
LINE N
LINE O
LINE P
LINE Q



MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

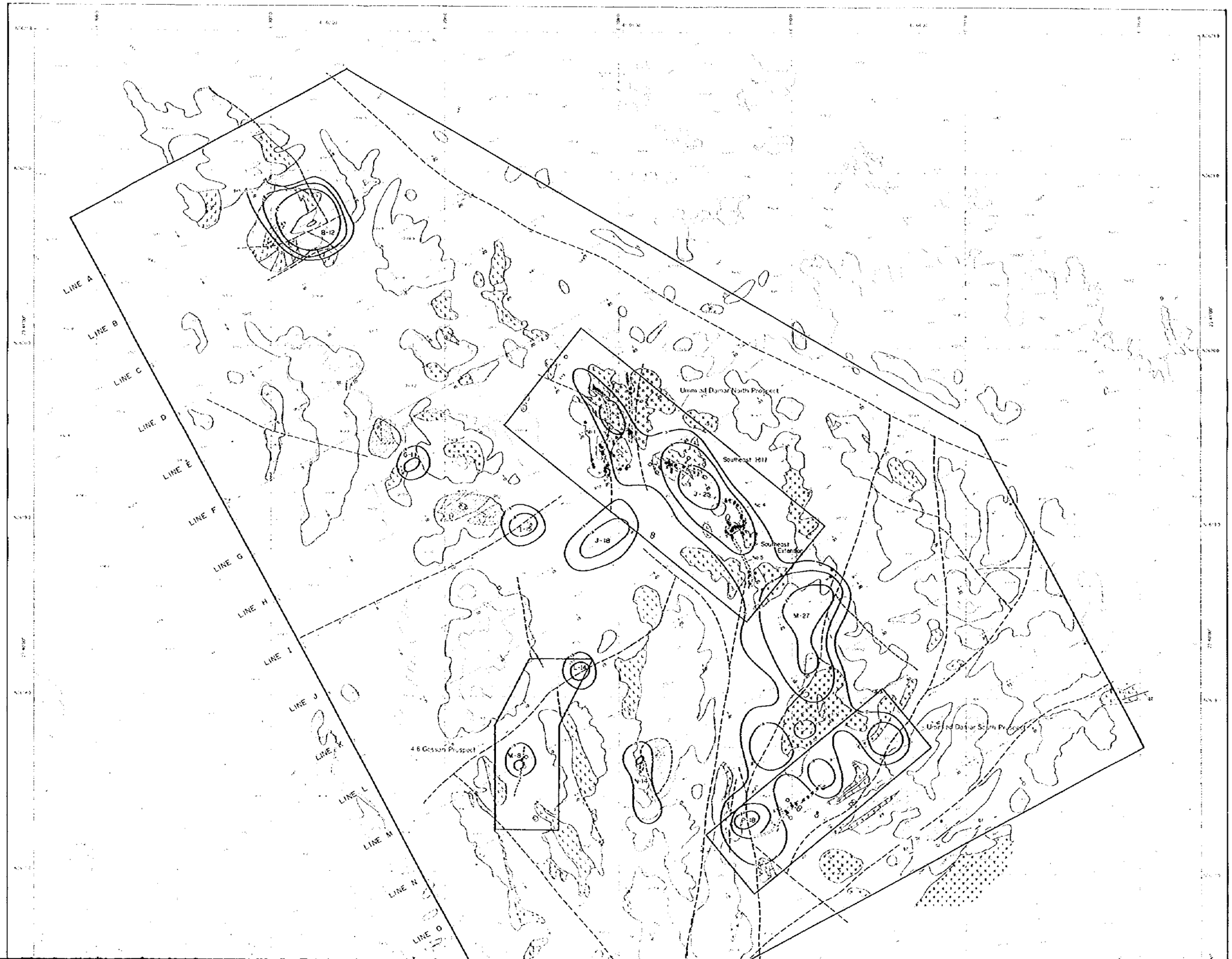
LEGEND

Chargeability

- Mx ≥ 24 mV/V
- 15 ≤ Mx ≤ 24 mV/V

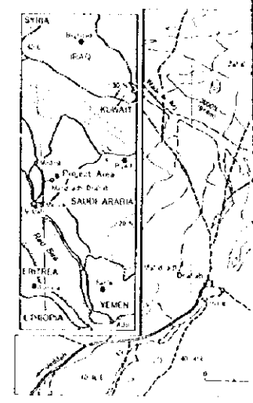
1:10,000

Umm ad Damar Area



REPORT ON THE COOPERATIVE MIN
IN THE UMM AD DAMA
THE KINGDOM OF SAUD
PHASE I

INTEGRATED INTERPRETATION MAP OF TH



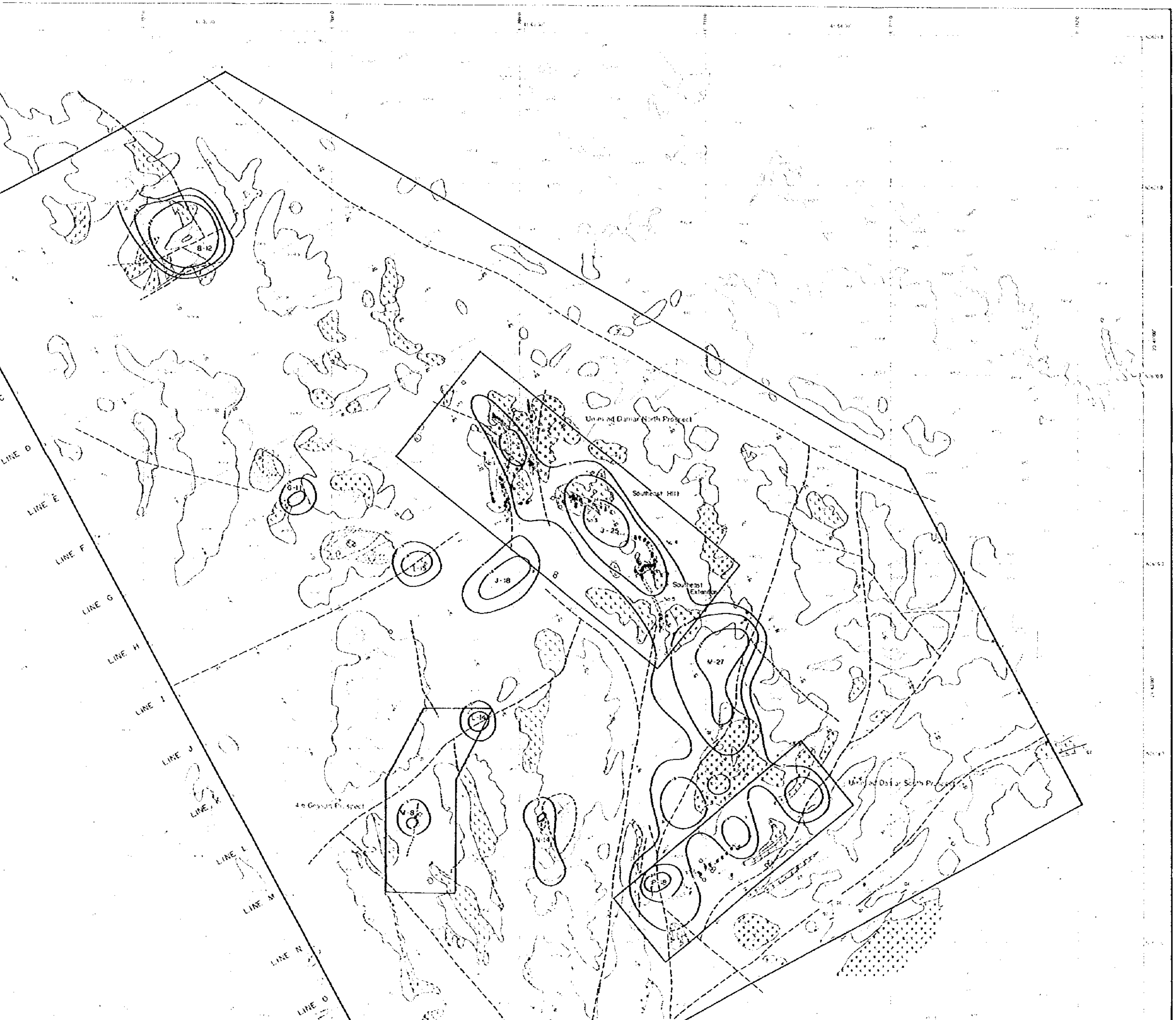
MARCH 1999

JAPAN INTERNATIONAL COOPERAT
METAL MINING AGENCY O

LEGEND

- Chargeability
- Quaternary gravel & sand
- Arj Group rhyodacite
- Arj Group jasper
- Diorite, tuffite
- Other rocks
- Slag
- Fault
- Carbonatization
- Silicification
- Epidotization & arch sil
- Mineralized zone

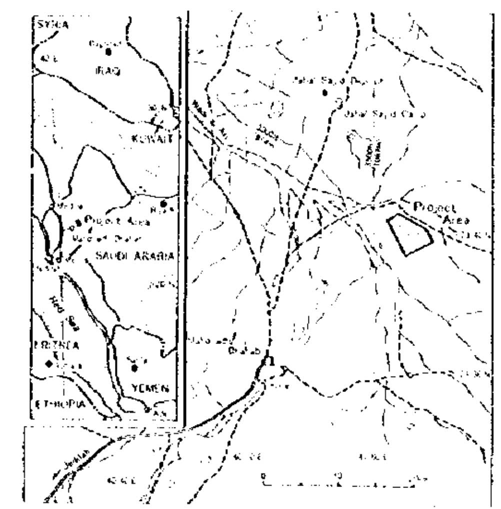
amar Area



PL. 7

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

INTEGRATED INTERPRETATION MAP OF THE SURVEY AREA

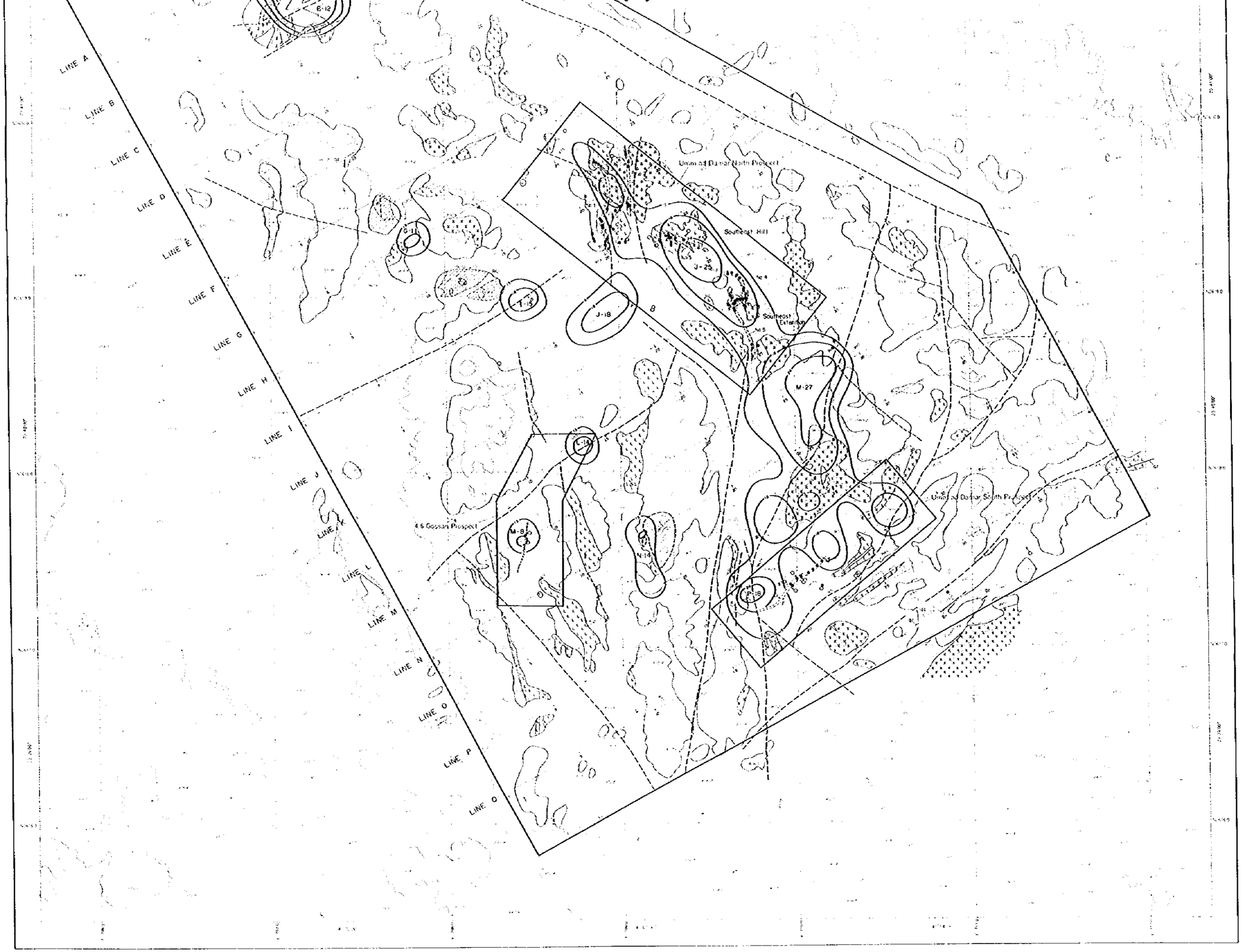


MARCH 1990

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

Chargeability
Quaternary gravel & sand
Fault

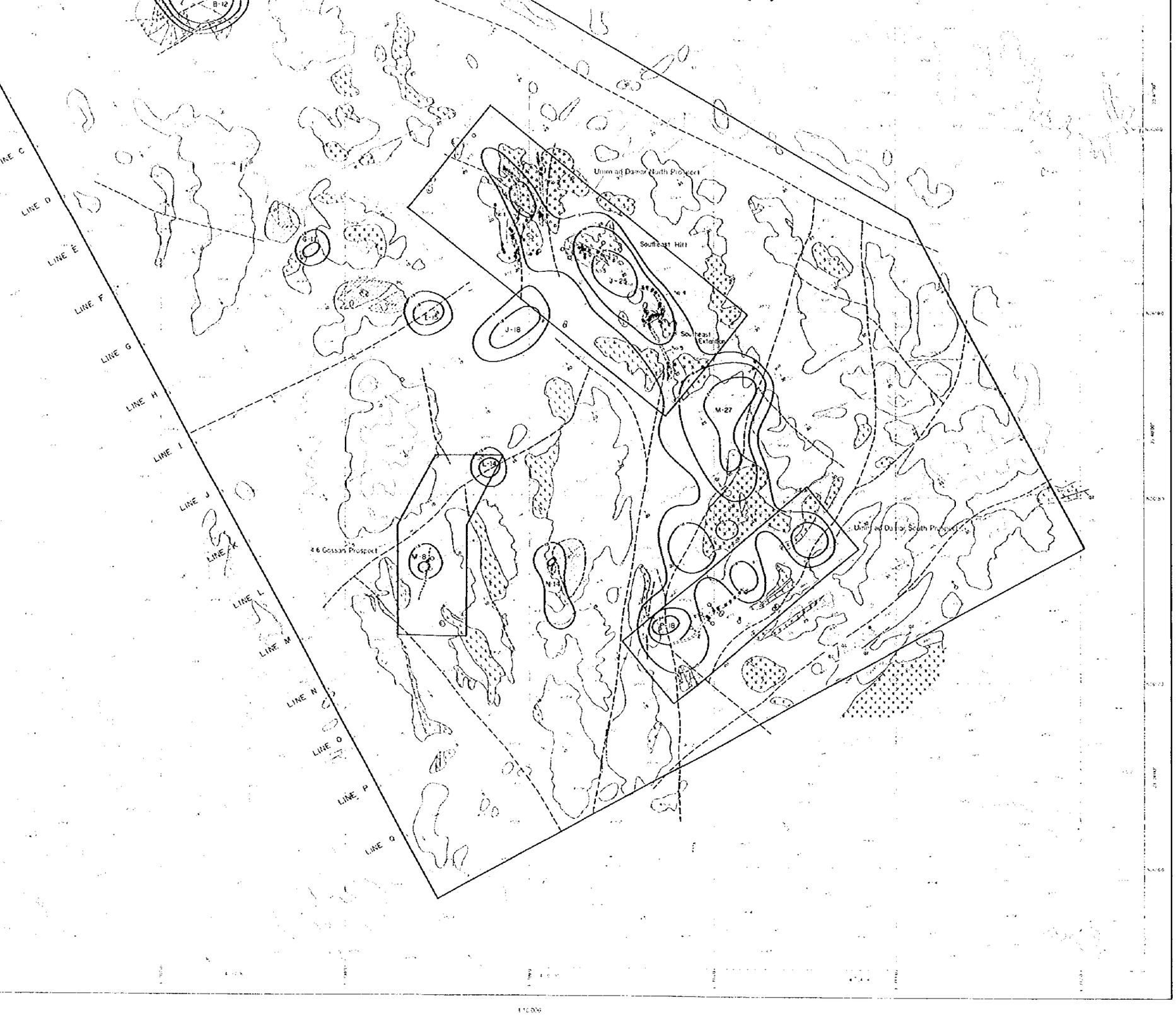


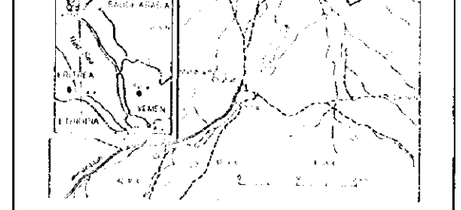
MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

- Chargeability
- Quaternary gravel & sand
- Arj Group rhyodacite
- Arj Group jasper
- Diorite, tonalite
- Other rocks
- Slag
- Fault
- Carbonatization
- Silicification
- Epidotization & weak silicific
- Mineralized zone
- Drill hole
- Ancient working
- Quartz vein
- IP survey line





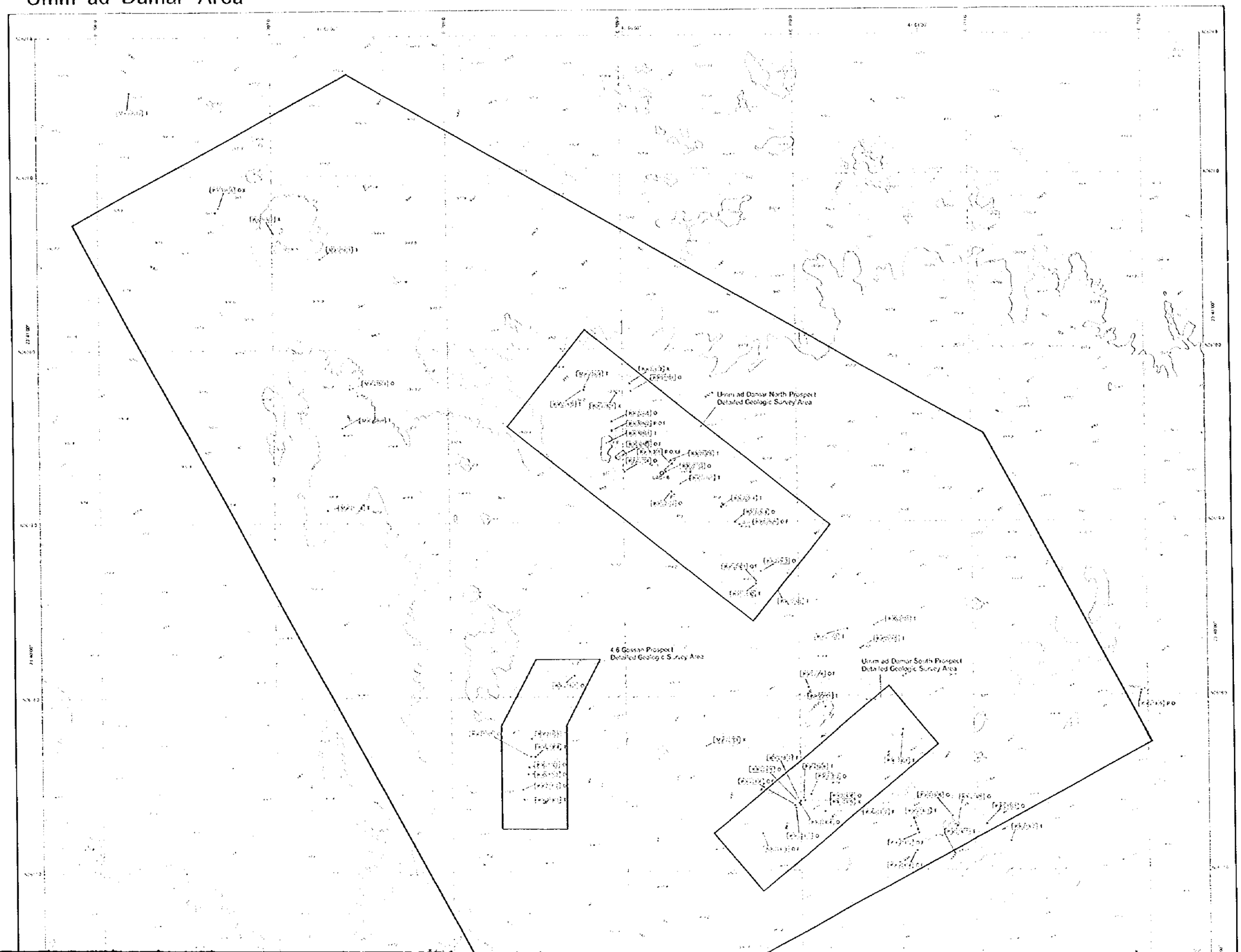
MARCH 1990

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

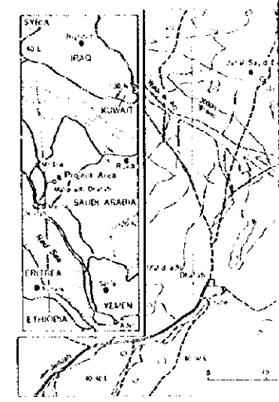
- Chargeability
- Quaternary gravel & sand
- Arj Group rhyodacite
- Arj Group jasper
- Diorite, tonalite
- Other rocks
- Slag
- Fault
- Carbonatization
- Silicification
- Epidotization & weak silicification
- Mineralized zone
- Drill hole
- Ancient working
- Quartz vein
- IP survey line

Umm ad Damar Area



REPORT ON THE COOPERATIVE MINERAL
IN THE UMM AD DAMAR ARE
THE KINGDOM OF SAUDI ARA
PHASE II

SAMPLING LOCATION MAP (1:3



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JAPAN INTERNATIONAL COOPERATION
METAL MINING AGENCY OF JA

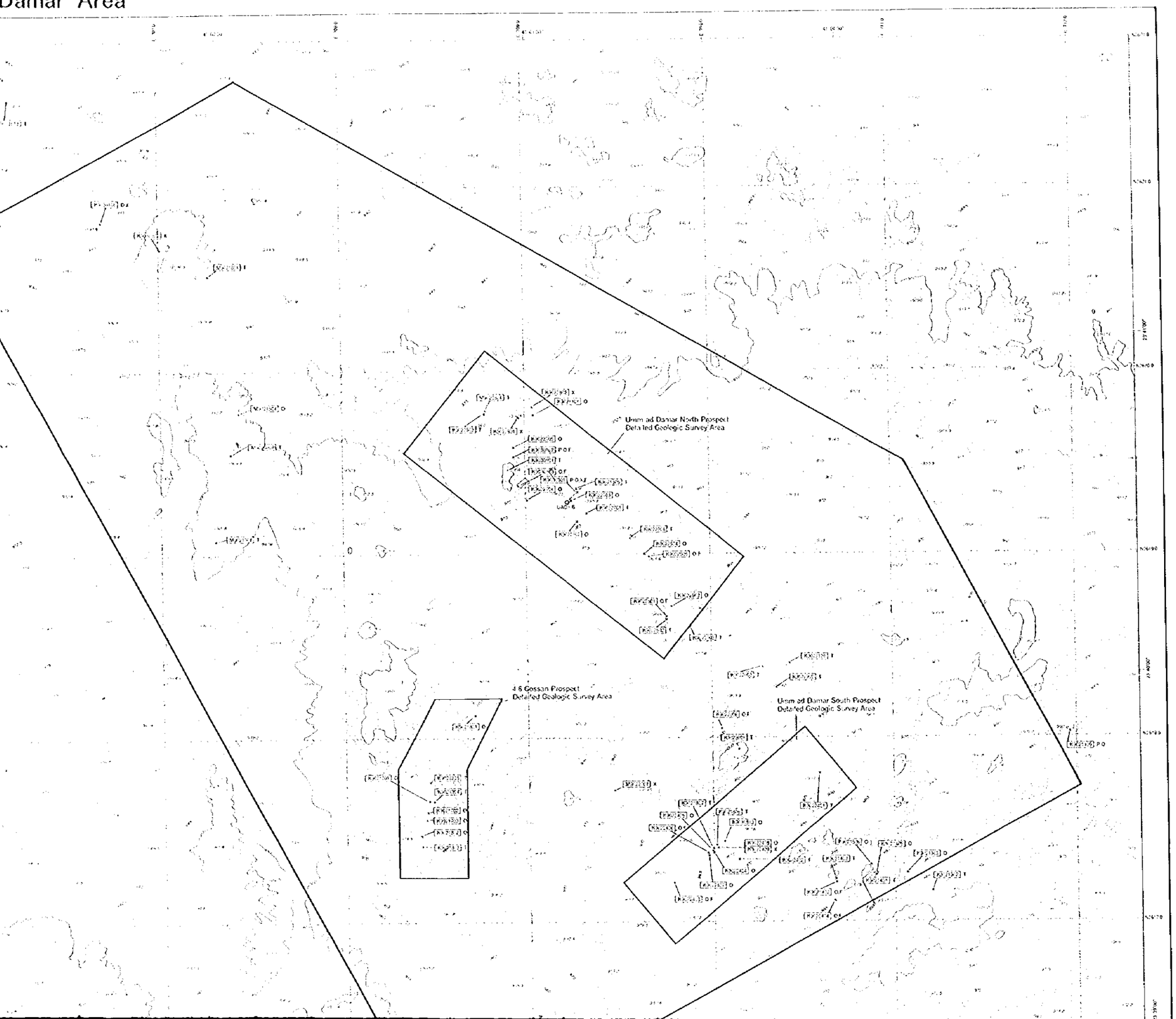
LEGEND

F : Thin Section
P : Polished Section(Ore Microscopy
O : Ore Assay
X : X-ray Diffraction Analysis
F : Fluid Inclusion Study

Other Samples

K9030303	X	Collected from Jubal Sayid Dep
K9030305	P	
K9030306	P	
K9030307	P, F	
K9030308	P, F	Collected from Mahd adh Dhah
K9030309	X, F	
K9030310	P, X	

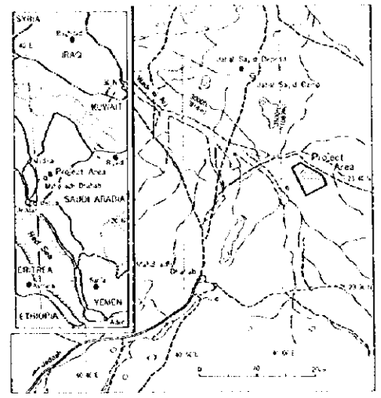
Damar Area



PL 8

REPORT ON THE COOPERATIVE MINERAL EXPLORATION
IN THE UMM AD DAMAR AREA
THE KINGDOM OF SAUDI ARABIA
PHASE I

SAMPLING LOCATION MAP (1:10,000)



MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

T : Thin Section
P : Polished Section(Ore Microscopy)
O : Ore Assay
X : X-ray Diffraction Analysis
F : Fluid Inclusion Study

Other Samples

- [K9030303] X
- [K9030305] P
- [K9030306] P
- [K9030307] P, F

} Collected from Jabal Sayid Deposit

- [K9030308] P, F
- [K9030309] X, F
- [K9030310] P, X

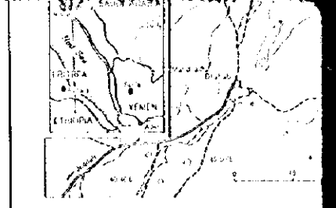
} Collected from Mahd adh Dhahab Mine

Umm ad Damar North Prospect
Detailed Geologic Survey Area

4.6 Gossan Prospect
Detailed Geologic Survey Area

Umm ad Damar South Prospect
Detailed Geologic Survey Area

1:10,000



MARCH 1989

JAPAN INTERNATIONAL COOPERATION AG
METAL MINING AGENCY OF JAPA

LEGEND

T : Thin Section
P : Polished Section(Ore Microscopy)
O : Ore Assay
X : X-ray Diffraction Analysis
F : Fluid Inclusion Study

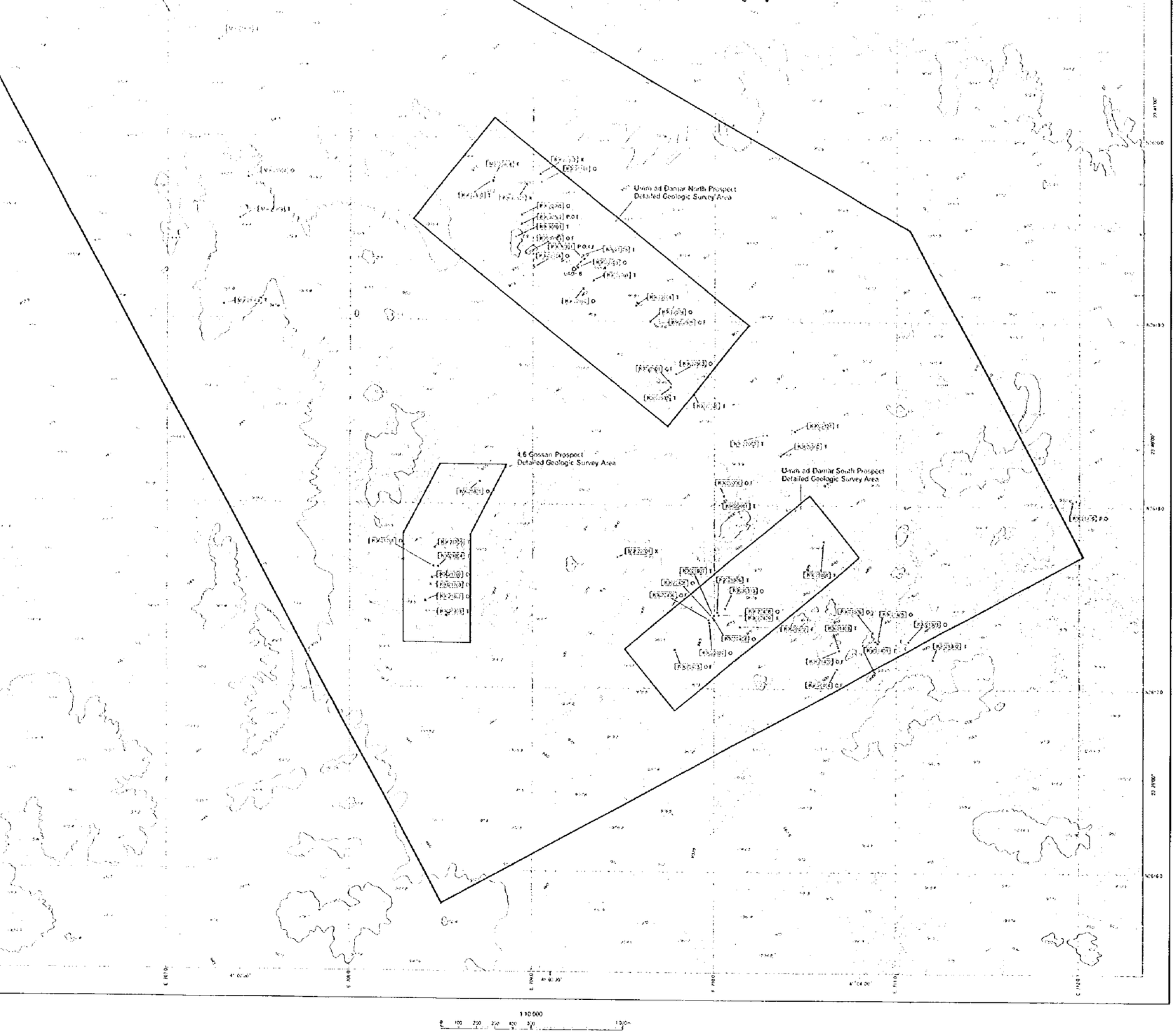
Other Samples

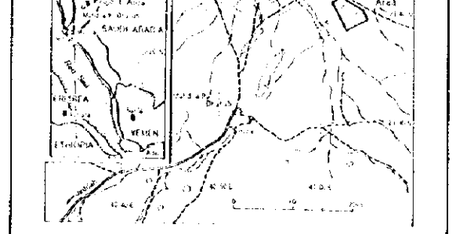
- [K9030303] X
- [K9030305] P
- [K9030306] P
- [K9030307] P, F

} Collected from Jabal Sayid Deposit

- [K9030308] P, F
- [K9030309] X, F
- [K9030310] P, X

} Collected from Mahd adh Dhahab





MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

LEGEND

T : Thin Section
P : Polished Section(Ore Microscopy)
O : Ore Assay
X : X-ray Diffraction Analysis
F : Fluid Inclusion Study

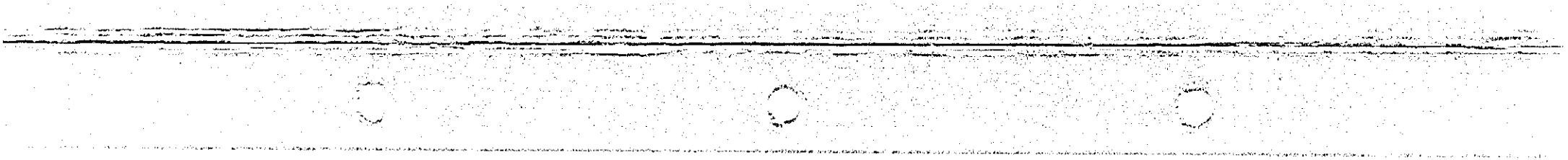
Other Samples

- K9030303 X
- K9030305 P
- K9030306 P
- K9030307 P, F

} Collected from Jabal Sayid Deposit

- K9030308 P, F
- K9030309 X, F
- K9030310 P, X

} Collected from Mahd adh Dhahab Mine



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