

References

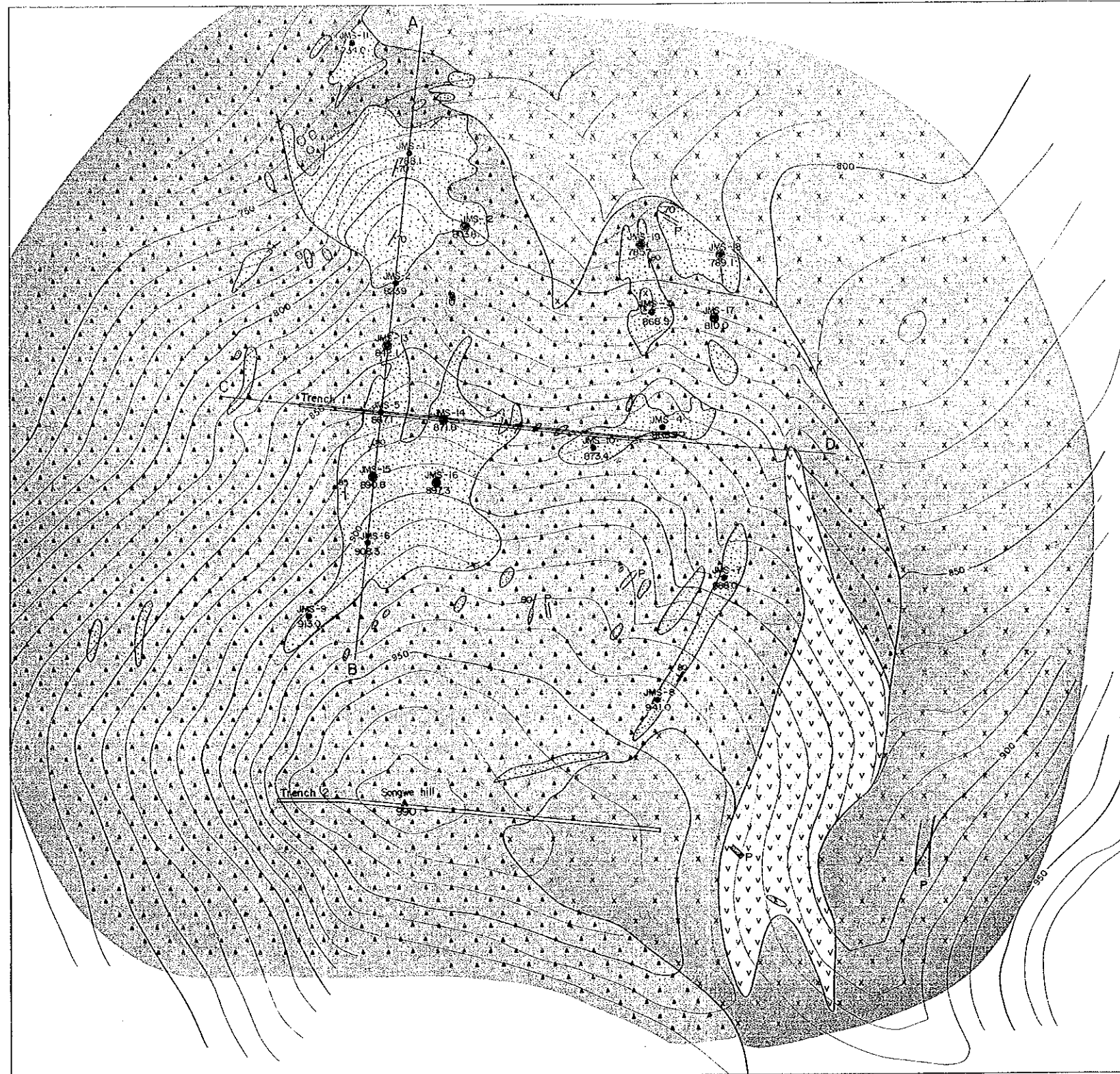
REFERENCES

- A special Contributor (1985): Malawi. Mining Annual Review - 1985, p433-435.
- Bloomfield, K. (1956): Infracrustal Ring-Complexes of Southern Malawi. Geol. Surv. Malawi, Memoir. no.4.
- Bloomfield, K. (1958): The Geology of the Port Herald Area. Geol. Surv. Malawi, Bull, no.9.
- Bloomfield, K. (1961): The Geochemistry of Zircons from Malawi alkaline rocks. Records of the Geol. Surv. Malawi, Vol.3, p.21-34.
- Bloomfield, K. (1965): The Geology of the Zomba Area. Geol. Surv. Malawi, Bull. no.16.
- Bloomfield, K. and Garson, M.S. (1965): The Geology of the Kirk Range-Lisungwe Valley Area. Geol. Surv. Malawi, Bull. no.17.
- Bureau of Mines (1984): Malawi. Mineral Yearbook - 1984, vol. 3, p.952.
- Cannon, R.T. (1970): Geological Atlas of Malawi, Sheet II, Zomba.
- Cooper, W.G.G. and bloomfield, K. (1961): The Geology of the Tambani-Salambidwe Area. Geol. Surv. Malawi, Bull. no.13.
- Deines, P. (1970): The carbon and oxgen isotopic composition of carbonates from the Oka carbonatite complex, Quebec, Canada, Geochim. Cosmochim. Acta 34.
- Dixey, F., Smith, W.C. and Bisset, C.B. (1955): The Chilwa Series of Southern Nyasaland. Geol. Surv. Malawi, Bull. no.5 (Revised).
- Evans, R.K. (1965): The Geology of the Shire Highlands. Geol. Surv. Malawi, Bull. no.18.
- Furon, R. (1963): The Rhodesias and Nyasaland. Geology of AFRICA. Oliver & Boyd Edinburgh and London, p.329-335.
- Garson, M.S. Smith, W.C. (1958): Chilwa Island. Geol. Surv. Malawi, Memoir no.1.
- Garson, M.S. (1960): The Geology of the Lake Chilwa Area. Geol. Surv. Malawi, Bull. no.12.
- Garson, M.S. (1961): The Geology of the Chimbiri Hills area, Mlanje District. Records of the Geol. Surv. Malawi, vol.3, p.21-34.
- Garson, M.S. (1961): The Geology of the Area West of Lake Malombe, Fort Johnston District. Records of the Geol. Surv. Malawi. vol.3, p.35-48.
- Garson, M.S. (1962): The Tundulu Carbonatite Ring-Complex in Southern Nyasaland. Geol. Surv. Malawi, Memoir no.2.

- Komura, K. (1981): Niobium and Tantalum Resources in Africa. *Newer Metal Industry*, no.302, p.1-8. (in Japanese)
- Le Bas, M.J. (1977): *Carbonatite-Nephelinite Volcanism*. John Wiley&Sons, London, 347p.
- Metal Mining Agency of Japan (1981): 1980 Report of Development and Research in Mineral Resource Exploration - Remote Sencing - p.1-36. (in Japanese)
- Metal Mining Agency of Japan (1982): 1981 Report of Development and Research in Mineral Resource Exploration - Remote Sencing - p.1-56. (in Japanese)
- Metal Mining Agency of Japan, Mining Information Center (1971): *Metallogenic Province in Africa*. Research Analysis Committee, no.6, p.1-56. (in Japanese)
- Metal Mining Agency of Japan, Mining Information Center (1972): *Structure in Africa, Metallogenic Province and its Units*. Research Analysis Committee, no.12, pl-26. (in Japanese)
- Metal Mining Agency of Japan, Mining Information Center (1973): *Mining Circumstance in Malawi*. Overseas Information. no.42, p.1-22. (in Japanese)
- Metal Mining Agency of Japan, Mining Information Center (1975): *Summary of Mining Act in the World, Malawi*. Overseas Information. no.70, p.75-79. (in Japanese)
- Metal Mining Agency of Japan, Mining Information Center (1982): 1982 Report of Geological Analysis Committee, Niobium Tantalium. p.70-85. (in Japanese)
- Metal Mining Agency of Japan, Mining Information Center (1982): 1982 Report of Development and Environment Analysis Committee. *Mineral Resources and their Development and Environment in Central and South Africa*, p.110-121. (in Japanese)
- Morel, S.W. (1958): *The Geology of the Middle Shire Area*. Geol. Surv. Malawi, Bull. no.10. 4th Prelim. Rept. Afr. Studies, Nagoya Univ., p.175-179.
- Ohde, S., Suwa, K. and Kitano, Y. (1979): *Trace Element Geochemistry of Carbonatites from Homa Mountain, Kenya*. 4th Prelim. Rept. Afr. Studies, Nagoya Univ., P.169-174.
- Okano, T. (1981): *On the Niobium and Tantalium Mineral Resources*. *Mining Geology*, vol.31, no.5, p.407-414. (in Japanese)
- Pennant, T. (1985): *Malawi*. Africa Review 1985 Ninth Edition of Africa Guide, World of Information England, p.189-192.
- Peters, E.R. (1975): *Geochemical Soil Sampling of the Tundulu, Chilwa Island and Kangankunde carbonatite Complexes*. *Records of the Geol. Surv. Malawi*, vol.8, p.1-16.

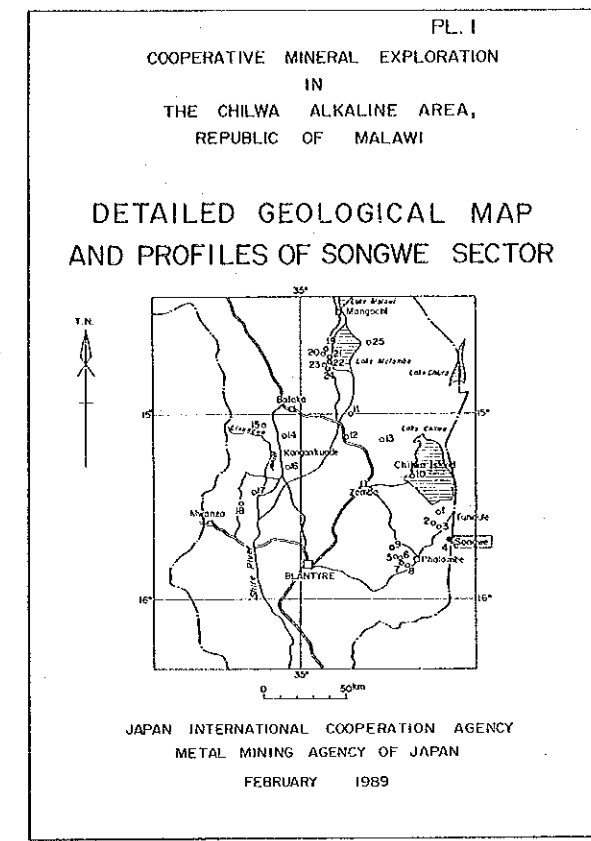
- Garson, M.S. (1965): Carbonatite and Agglomeratic Vents in the Western Shire Valley. Geol. Surv. Malawi, Memoir no.3.
- Garson, M.S. (1965): Carbonatites in Southern Malawi. Geol. Surv. Malawi, Bull. no.15.
- Garson, M.S. (1966): Carbonatites in Malawi. in "Carbonatites" ed. Tuttle and Gittins, P33-71.
- Garson, M.S. and Morgam, D.L. (1977): Secondary Strontianite at Kangankunde Carbonatite Complex, Malawi. I.M.M. Trans., vol.87, B70-73.
- Garson, M.S. and Walshaw, R.D. (1969): The Geology of the Mlanje Area. Geol. Surv. Malawi, Bull. no.21.
- Geological Survey Department of Malawi (1985): Airborne Geophysical Survey maps.
- Geological Survey of Japan and Departamento Nacional da Producao Mineral (1987): Research on Mineral Deposits Associated with Carbonatite in Brazil. ITIT Projects No. 8316
- Habgood, F., Holt, D.N. and Walshaw, R.D. (1973): The Geology of the Thyolo Area. Geol. Surv. Malawi, Bull. no.22.
- Hida, N. (1970) : Rare Earth. Newer Metal Industry, March, P.7-14. (in Japanese)
- Holt, D.N. (1965): The Kangankunde Hill Rare Earth Prospect. Geol. Surv. Malawi, Bull. no.20.
- Hutcheson, A.M. (1971): Atlas for Malawi. Collins&Longman Atlases 1971.
- Japan International Cooperation Agency (1981): Life in Africa, Malawi. International Cooperation Service Center.(in Japanese)
- Japan International Cooperation Agency and Metal Mining Agency of Japan (1987): Report on the Cooperative Mineral Exploration in the Chilwa Alkaline Area, Republic of Malawi (Phase I)
- Japan International Cooperation Agency and Metal Mining Agency of Japan (1988): Report on the Cooperative Mineral Exploration in the Chilwa Alkaline Area, Republic of Malawi (Phase II)
- Kamiya, M. (1982): Rare Metal(1). Bonanza, Metal Mining Agency of Japan, no.81, p8-22. (in Japanese)
- Kamiya, M. (1982): Rare Metal(2). Bonanza, Metal Mining Agency of Japan, no.82, p.12-28. (in Japanese)
- Kishimoto, F. (1985): On the Bayan Obo Rare-Earth-Niobium-Iron Ore Deposits of China. Journal of Geography, vol.94, no.4 P.30-47. (in Japanese)

- Rose, A.W., Hawkes, H.E. and Webb, J.S. (1979): *Geochemistry in Mineral Exploration*. Academic Press, London, 657p.
- Suwa, K., Osaki, S., Oana, S., Shiida, I. and Miyakawa, K. (1969): *Isotope Geochemistry and Petrology of the Mbeya Carbonatite, south-western Tanzania, East Africa*. *J. Earth Sci, Nagoya Univ.* 17, P125-168
- Suwa, K., Oana, S., Wada, H. and Osaki, S. (1975): *Isotope Geochemistry and Petrology of African Carbonatites*. *Phys. Chem. Earth*, 9, Pergamon Press, P735-746
- Suwa, K. (1981): *Petrology of Carbonatite*. *Mining Geology*, vol.31, no.6, p.457-465. (in Japanese)
- Takenouchi, S. (1973): *Carbonatite Ore Deposits(I)* *Mining Geology*, vol.23, no.5, p.367-382. (in Japanese)
- Takenouchi, S. (1973): *Carbonatite Ore Deposits(II)* *Mining Geology*, vol.23, no.6, p.437-451. (in Japanese)
- Takenouchi, S. (1981): *Carbonatite Deposits*. *Mining Geology*, vol.31, no.5, p.415-420. (in Japanese)
- Takenouchi, S., Kanehira, K., Komura, K. and Mariko, T. (1986): *Lithium, Beryllium, Niobium, Tantalum, Rare Earth Elements, and Zirconium, Hafnium Ore Deposits-Resources of Rare Metal 2-* *Mining Geology*, vol.36, no.4, p.291-312. (in Japanese)
- Tanaka, T. (1981): *Rare-Earth Behavior in Magmatism and Genesis of Carbonatite*. *Mining Geology*, vol.31, no.6, p.467-478. (in Japanese)
- Tatsumi, T. (1965): *Mineral Deposits Associated with Carbonatite and Alkaline Complexes*. *Journal of Geography*, vol.74, no.1, p.13-33. (in Japanese)
- Tuttle, O.F. and Gittins, J.(ed.)(1966): *Carbonatites*. John Wiley&Sons, London, 591p.
- Vail, J.R. and Mallick, D.I.J. (1961): *The Mongolowe Hills nepheline-syenite ring-complex, southern Malawi*. *Records of the Geol. Surv. Malawi*, vol.3, p.49-60.
- Walshaw, R.D. (1961): *The Geology of the Balaka-Pirilongwe area*. *Records of the Geol. Surv. Malawi*, vol.3, p.5-20.
- Walshaw, R.D. (1965): *The Geology of the Ncheu-Balaka Area*. *Geol. Surv. Malawi, Bull. no.19*.

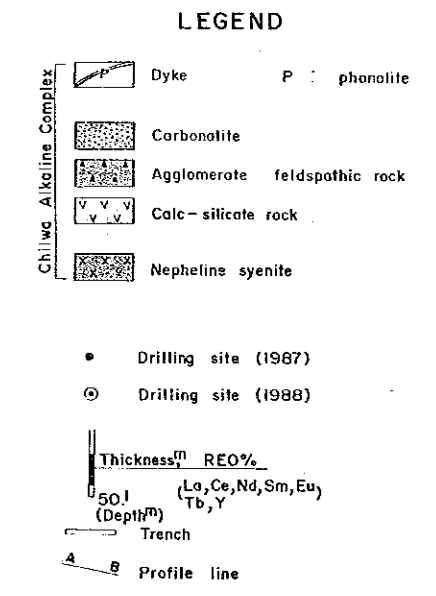


This map accompanies Report on the Cooperative Mineral Exploration in the Chilwa Alkaline area, Republic of Malawi (Consolidated Report), 1989.

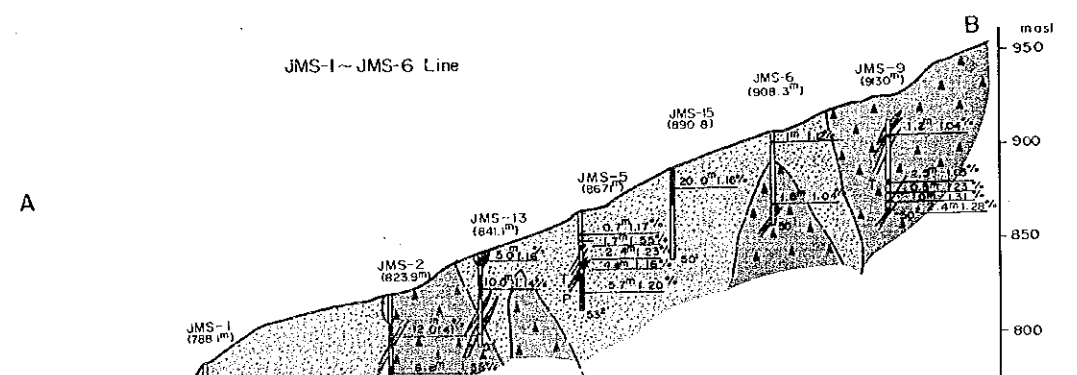
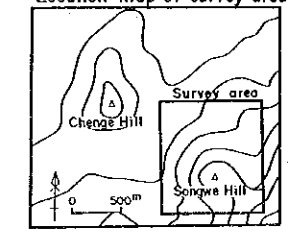
Japan International Cooperation Agency Ministry of Forestry and Natural Resources
Metal Mining Agency of Japan Department of Geological Survey

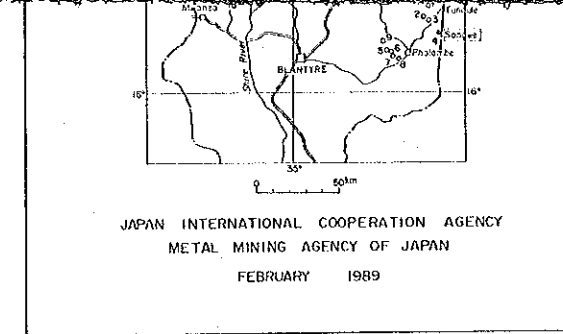
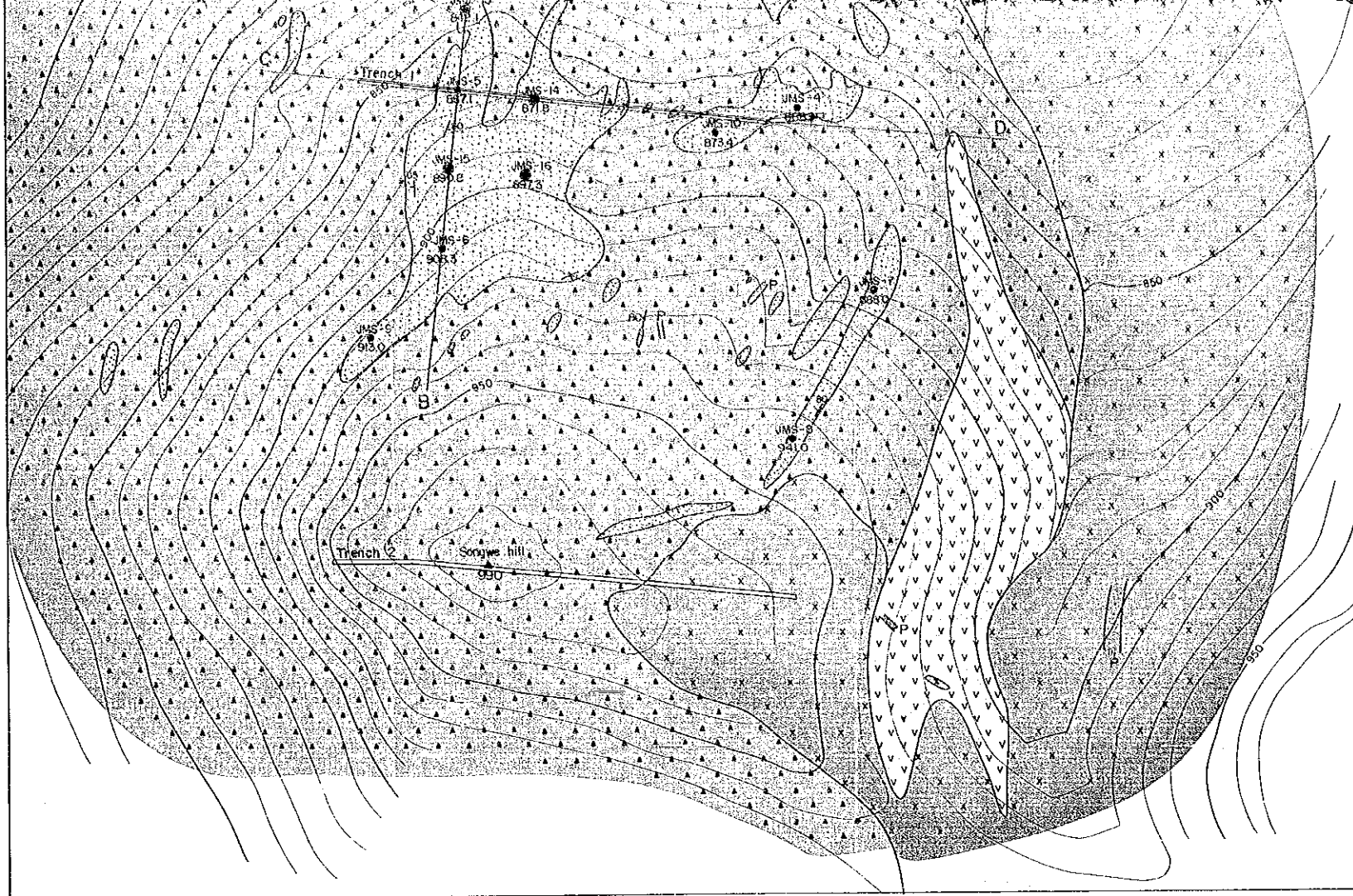


Scale 1 : 2,000



Location map of survey area

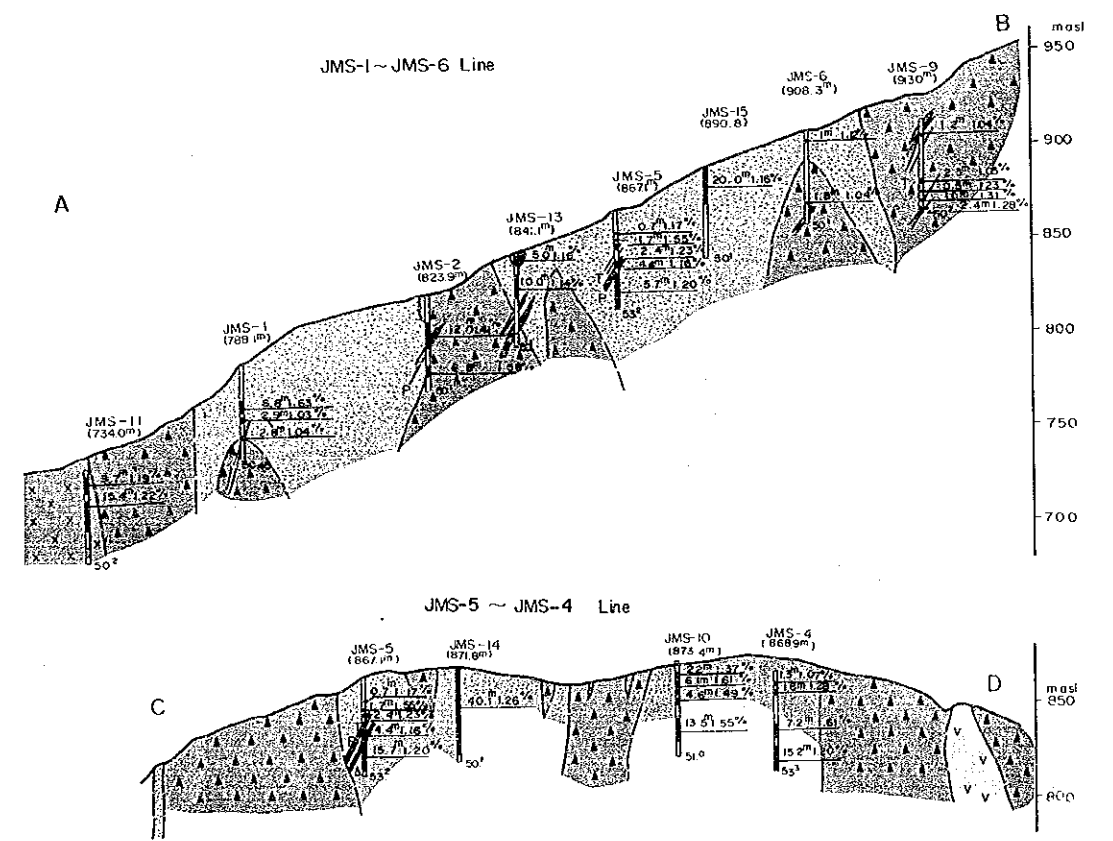
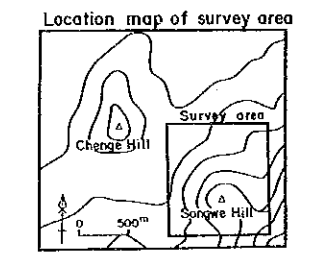


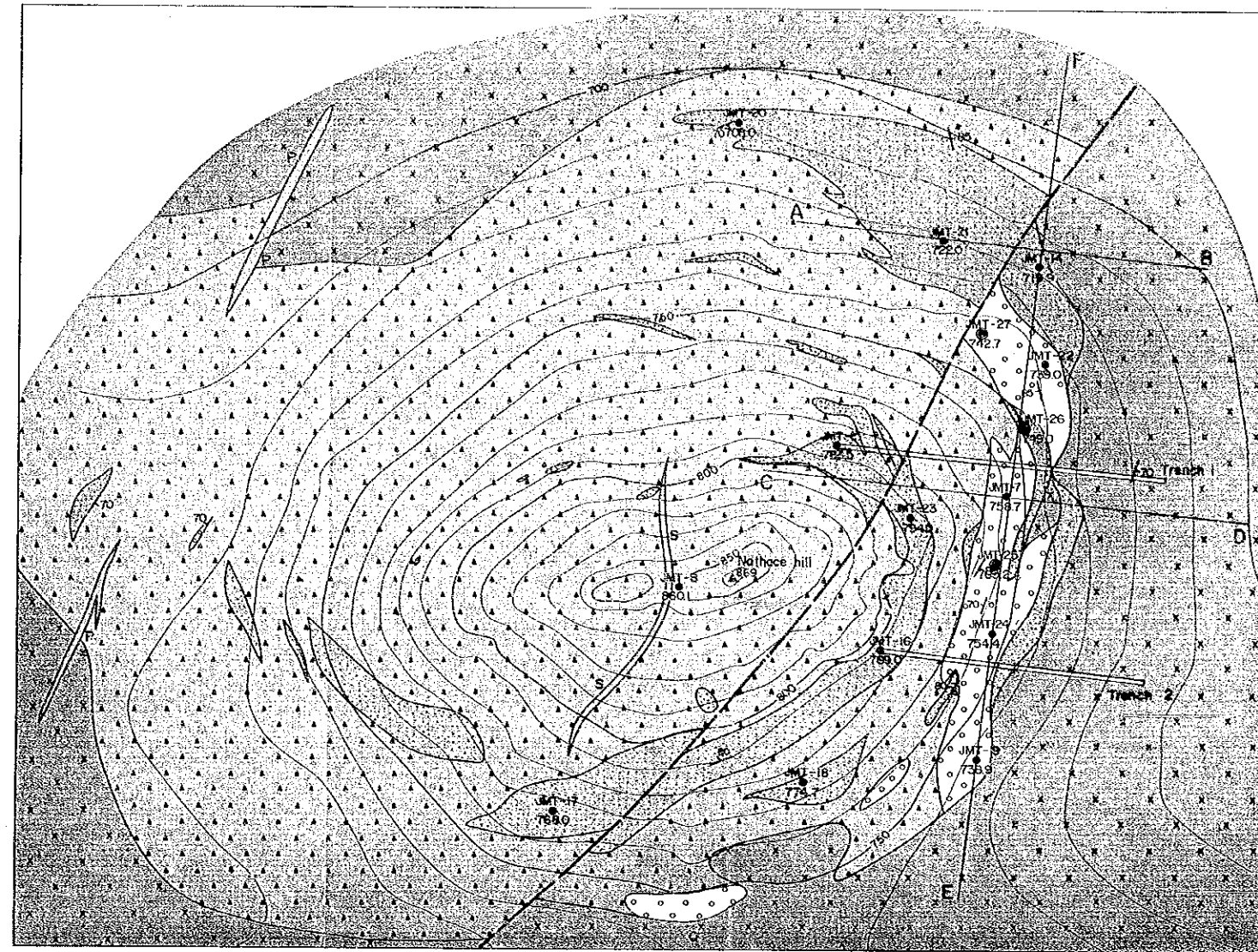


Scale 1 : 2,000

- LEGEND**
- Dyke
 - P : phonolite
 - Carbonatite
 - Agglomerate feldspathic rock
 - Calc-silicate rock
 - Nepheline syenite
 - Drilling site (1987)
 - ⊙ Drilling site (1988)
 - Thickness^m REO%
(La, Ce, Nd, Sm, Eu)
(Tb, Y)
 - Trench
 - A-B Profile line

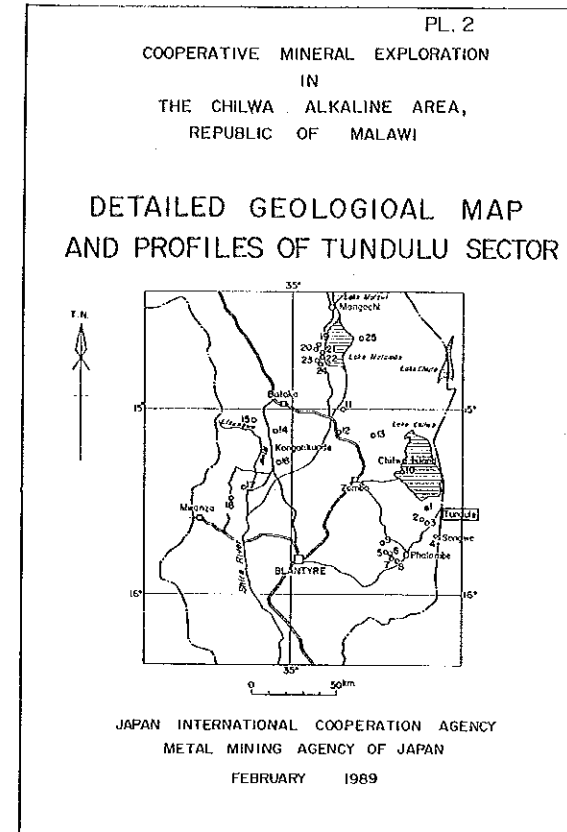
This map accompanies Report on the Cooperative Mineral Exploration in the Chitwa Alkaline area, Republic of Malawi (Consolidated Report), 1989.
 Japan International Cooperation Agency Ministry of Forestry and Natural Resources
 Metal Mining Agency of Japan Department of Geological Survey





This map accompanies Report on the Cooperative Mineral Exploration in the Chilwa Alkaline area, Republic of Malawi (Consolidated Report), 1989.

Japan International Cooperation Agency
Metal Mining Agency of Japan
Ministry of Forestry and Natural Resources
Department of Geological Survey

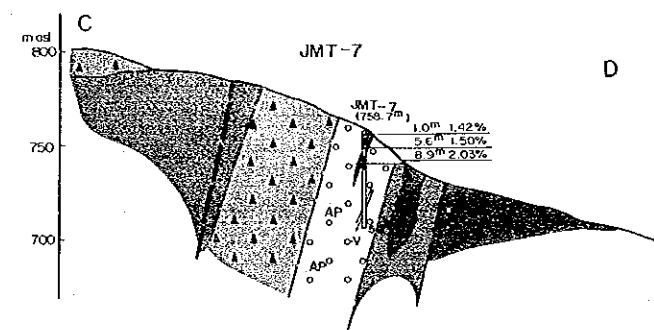
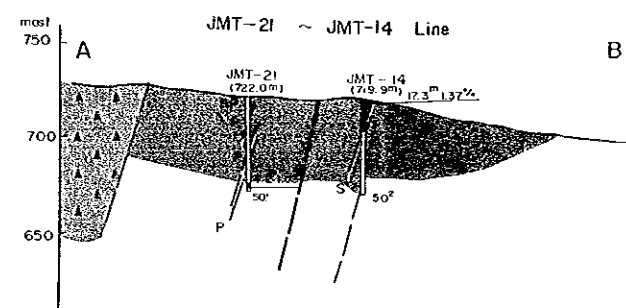


0m 100m 200m

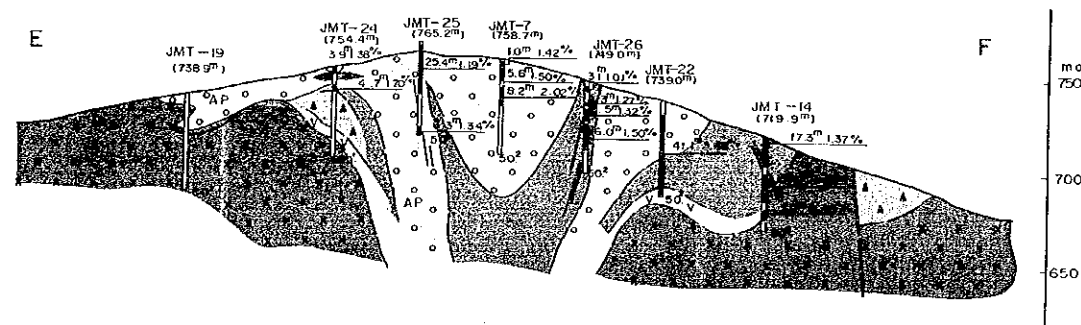
Scale 1 : 2,000

LEGEND

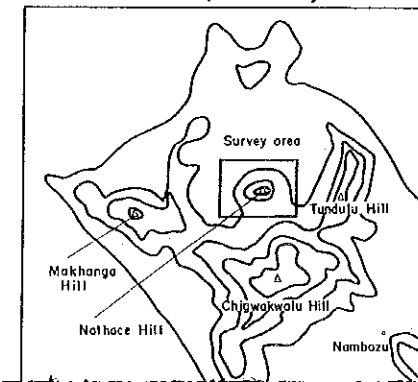
- Dyke plug
 - Carbonatite
 - Apatite rock
 - Agglomerate / feldspathic rock
 - Calc-silicate rock
 - Nepheline syenite
 - Fault
 - Drilling site (1987)
 - Drilling site (1980)
- Chilwa Alkaline Complex
- P : phonolite
S : solvsbergite
- Thickness, m REO%
(Depth) m
50.1 m (La, Ce, Nd, Sm, Eu)
Tb, Y
- Trench
- Profile line

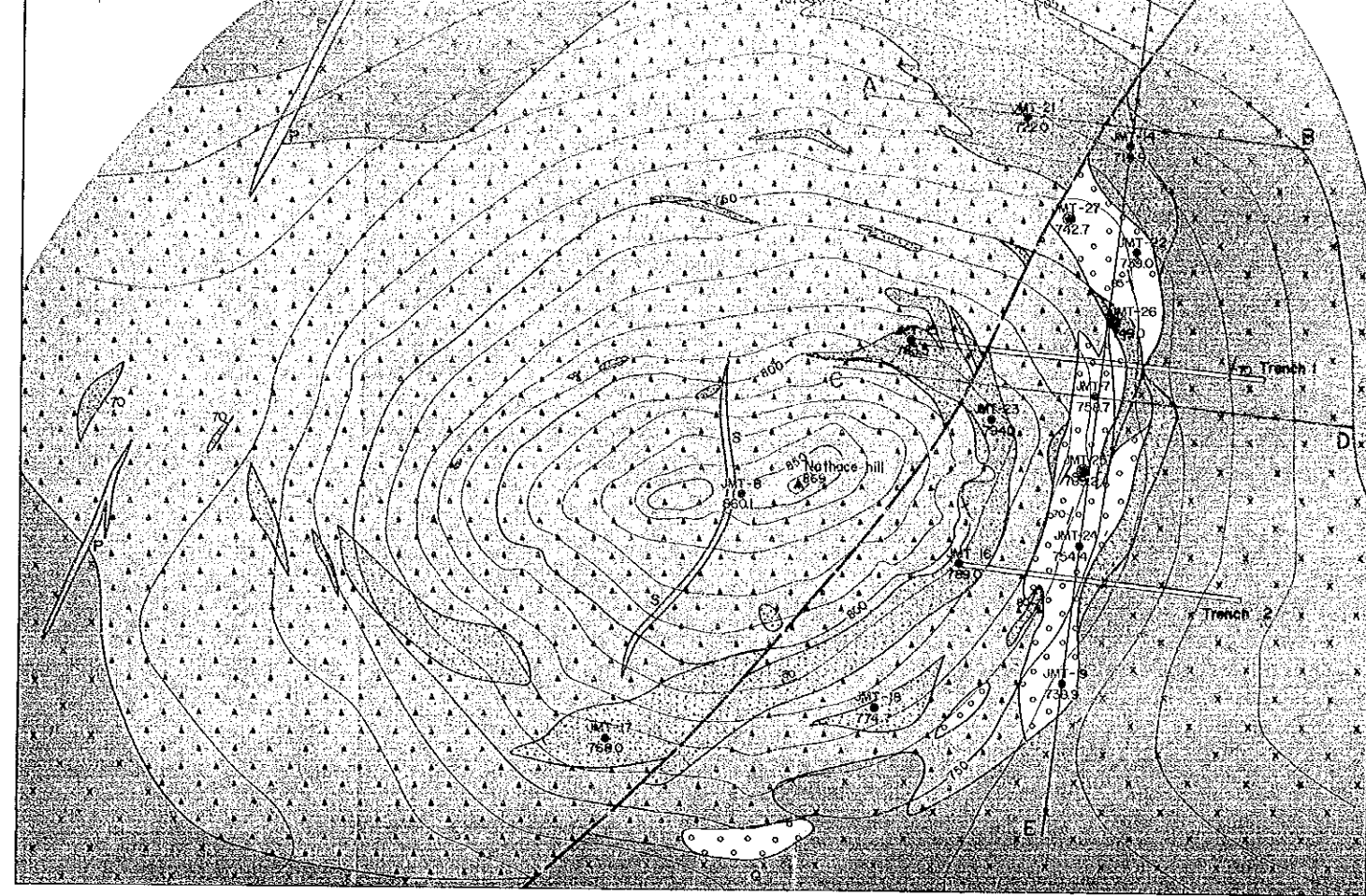


JMT-19 JMT-14 Line

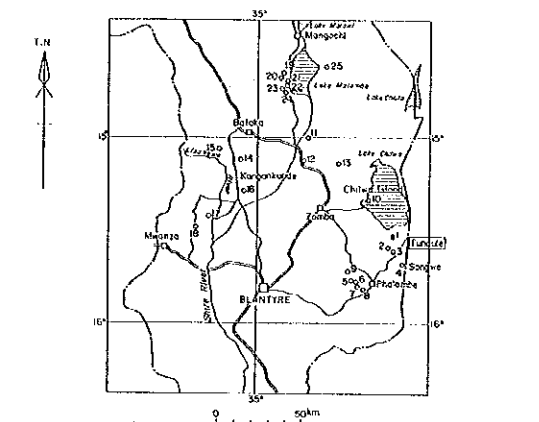


Location map of survey area

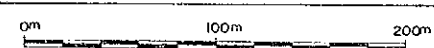




DETAILED GEOLOGICAL MAP AND PROFILES OF TUNDULU SECTOR



JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN
FEBRUARY 1989

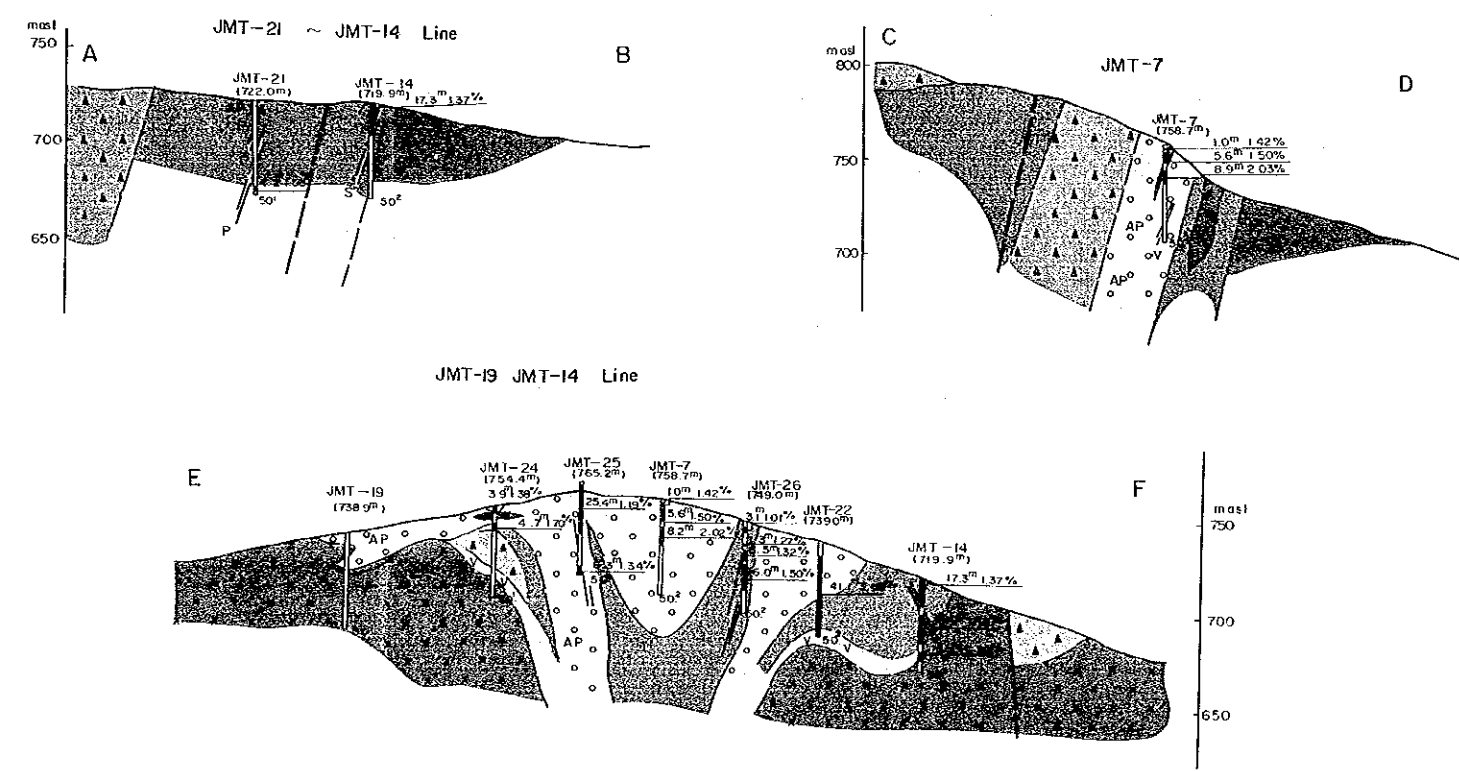


Scale 1 : 2,000

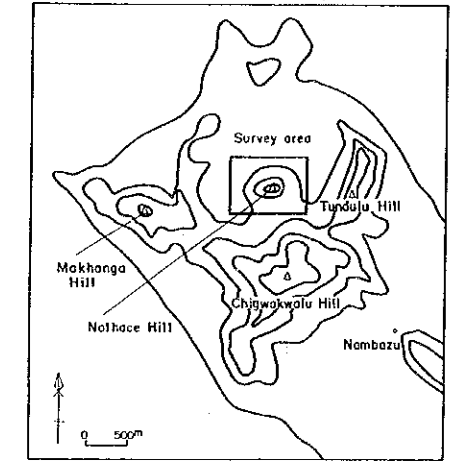
LEGEND

- Dyke plug
- Carbonatite
- Apatite rock
- Agglomerate / feldspathic rock
- Calc-silicate rock
- Nepheline syenite
- Fault
- Drilling site (1987)
- Drilling site (1980)
- | Thickness, m | REO% |
|--------------|----------------------|
| 50.1 | (La, Ce, Nd, Sm, Eu) |
| (Depth m) | (Tb, Y) |
- Trench
- Profile line

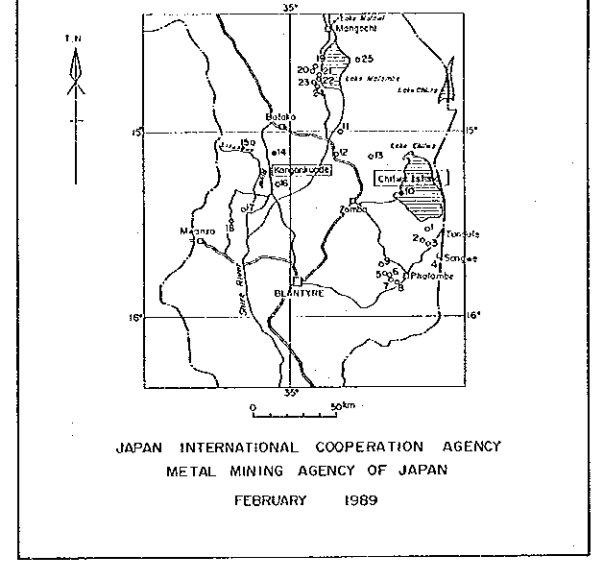
This map accompanies Report on the Cooperative Mineral Exploration in the Chilwa Alkaline area, Republic of Malawi (Consolidated Report), 1989.
Japan International Cooperation Agency Ministry of Forestry and Natural Resources
Metal Mining Agency of Japan Department of Geological Survey



Location map of survey area



GEOLOGICAL MAP AND PROFILES
 OF CHILWA ISLAND SECTOR



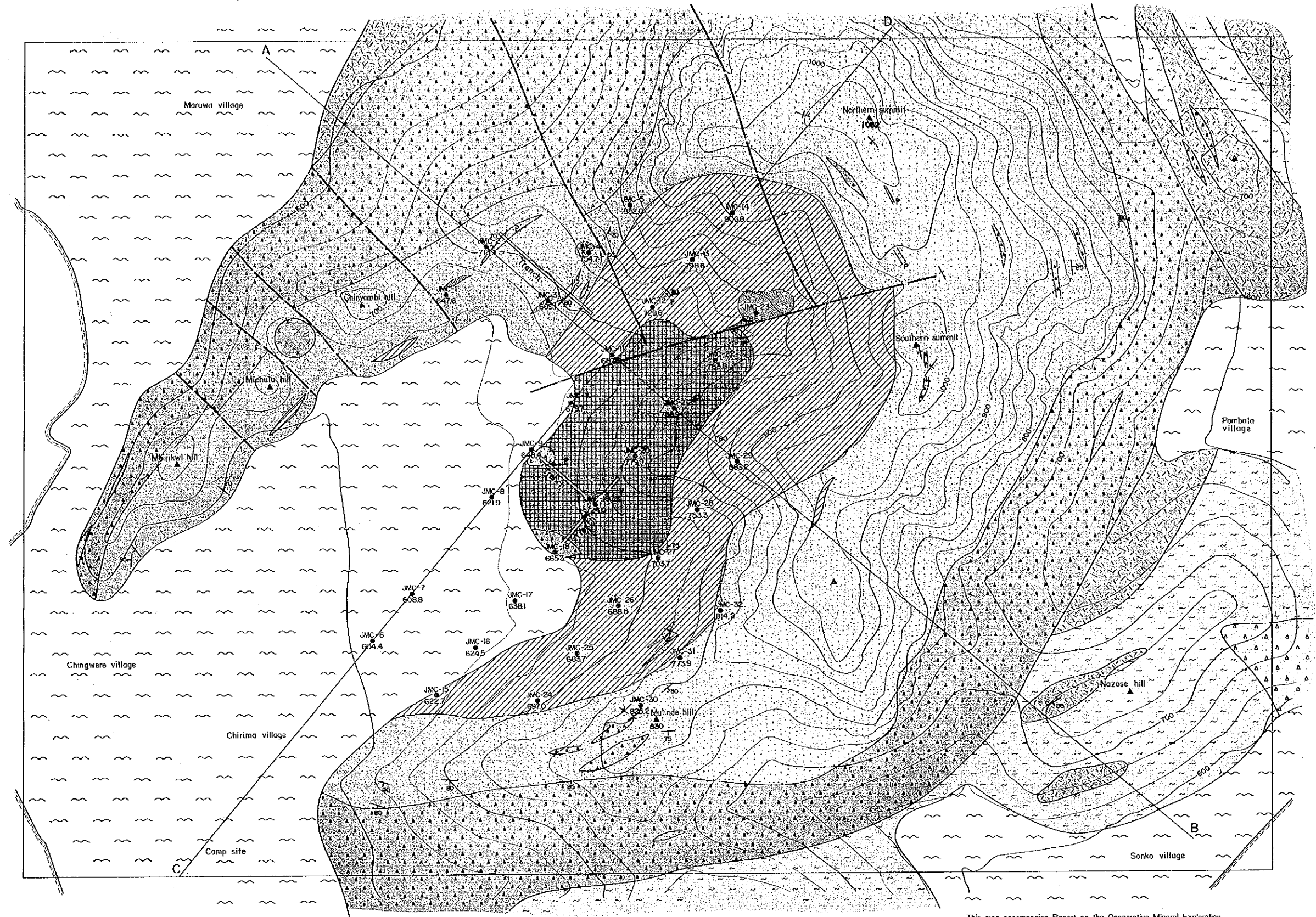
JAPAN INTERNATIONAL COOPERATION AGENCY
 METAL MINING AGENCY OF JAPAN
 FEBRUARY 1989

0m 250m 500m

Scale 1 : 5,000

LEGEND

- Drift
- Dyke P: phonolite
- Lamprophyre
- Ankeritic sövite
- Ankeritic sövite and Sideritic carbonatite mixed zone
- Sövite
- Feldspathic breccia
- Agglomerate
- Nepheline syenite
- Fenitized gneiss
- Fenitized syenite
- Fault
- Drilling site (1988)
- Trench
- Profile line

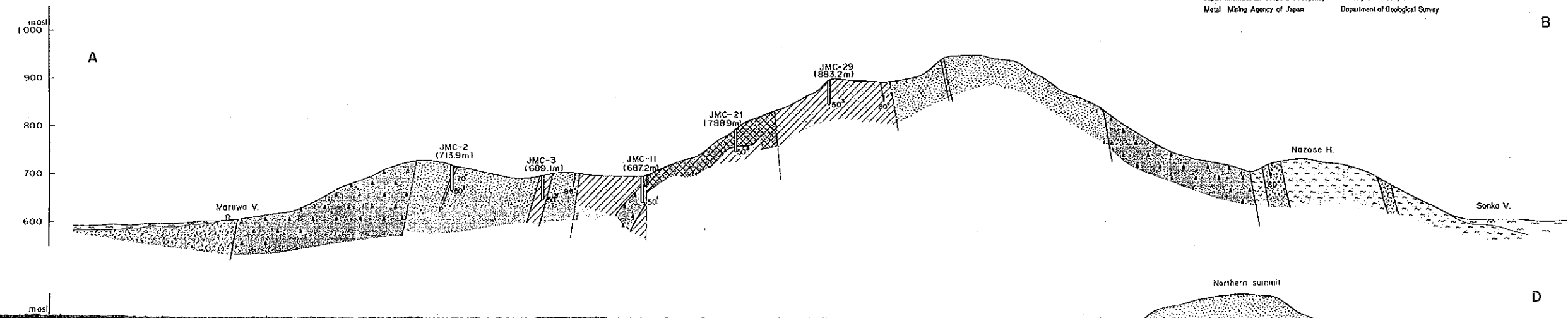


This map accompanies Report on the Cooperative Mineral Exploration in the Chilwa Alkaline area, Republic of Malawi (Consolidated Report), 1989.

Japan International Cooperation Agency
 Metal Mining Agency of Japan

Ministry of Forestry and Natural Resources
 Department of Geological Survey

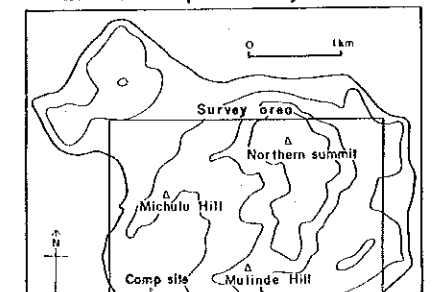
B

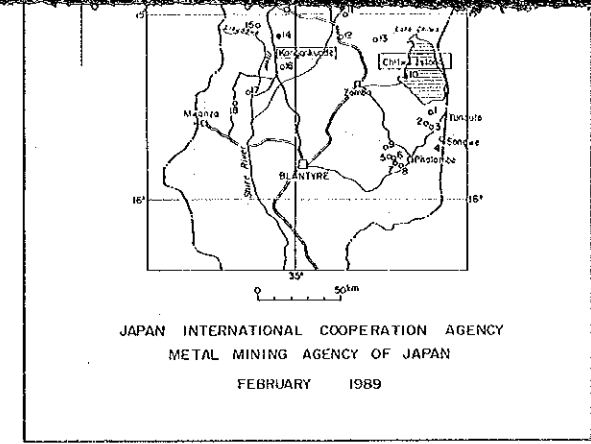


A

D

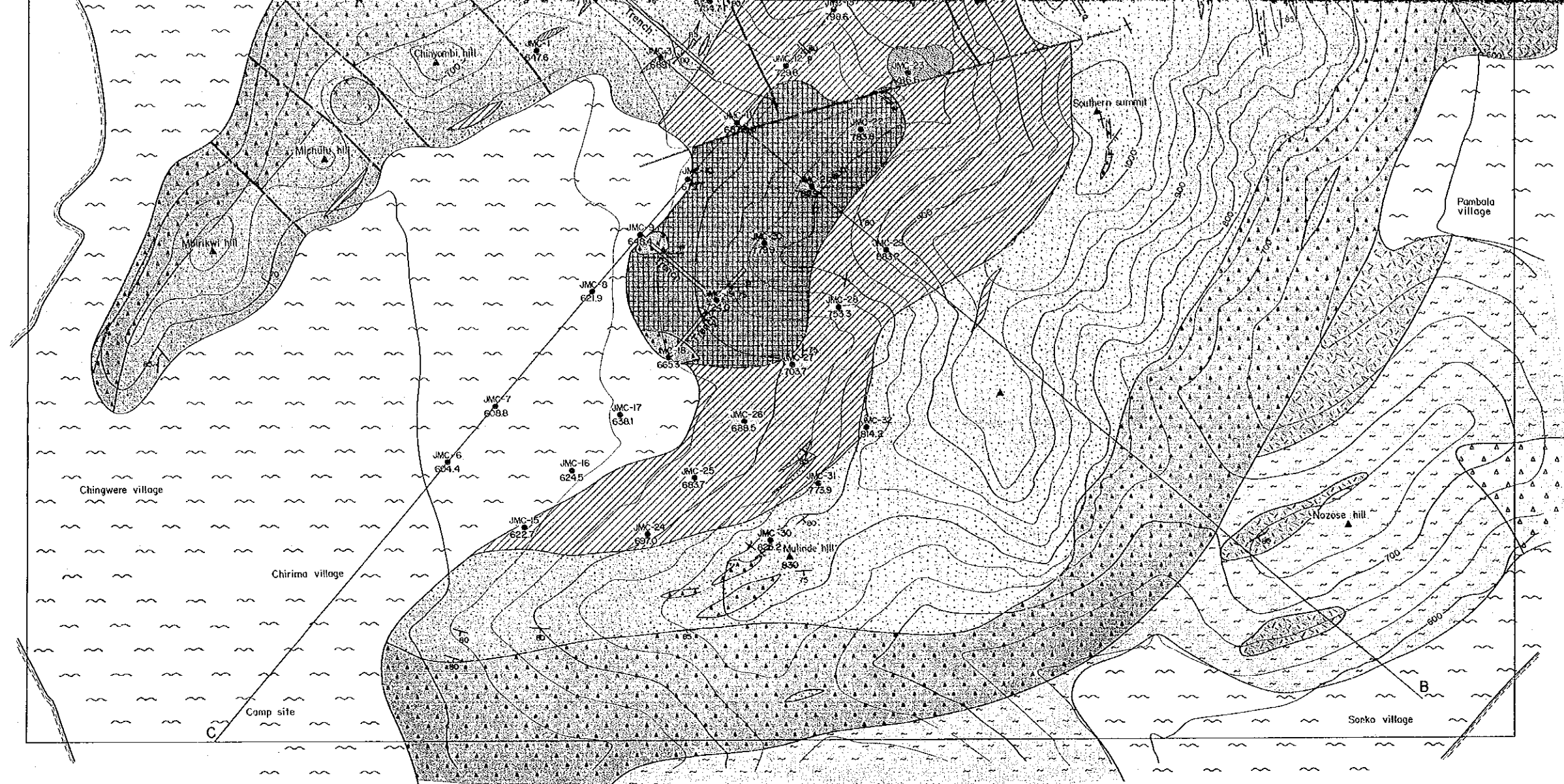
Location map of survey area





JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN
FEBRUARY 1989

Scale 1 : 5,000



- LEGEND**
- Drift
 - Dyke P : phonolite
 - Lamprophyre
 - Ankeritic sövite
 - Ankeritic sövite and Sideritic carbonatite mixed zone
 - Sövite
 - Feldspathic breccia
 - Agglomerate
 - Nepheline syenite
 - Fenitized gneiss
 - Fenitized syenite
 - Fault
- Chilwa Alkaline Complex**
- Drilling site (1988)
 - Trench
 - Profile line
- Basement Complex**
- Fenitized gneiss
 - Fenitized syenite
 - Fault

This map accompanies Report on the Cooperative Mineral Exploration in the Chilwa Alkaline area, Republic of Malawi (Consolidated Report), 1989.
Japan International Cooperation Agency
Metal Mining Agency of Japan
Ministry of Forestry and Natural Resources
Department of Geological Survey

