SHORTER COMMUNICATIONS

PARGASITES FROM MADAGASCAR

H. H. MAJMUNDAR

Department of Geology, Appalachian State University, Boone, N.C. 28607

Three samples of pargasite from extreme S.E. Madagascar were separated from the amphibolites (Pre-Cambrian) and studied briefly. All the three samples had been given to me for investigation by Dr. H. de La Roche, Assistant Director of the Center of Researches in Petrography and Geochemistry, C.N.R.S., Nancy, France.

Sample 1 comes from the phlogopite occurrences of Beampingaratra, 2 from Cuvette d'Esira and 3 from the uranothorianite deposits of Amboanemba.

X-ray powder patterns were obtained with both CuKα and FeKα radiations using a Philips generator. The results are shown in Table 1.

TABLE 1. X-RAY DIFFRACTION DATA FOR PARGASITES FROM S.E. MADAGASCAR

1 Pargasite, Beampingaratra, S.E. Madagascar		2 Pargasite, Esira, S.E. Madagascar		3 Pargasite, Amboanemba, S.E. Madagascar	
d(Å)	I	d(Å)	I	d(Å)	I
3.358	60	3.357	60	3.358	60
3.264	60	3.263	60	3.257	60
3.101	80	3.101	80	3.101	80
2.890	40	2.897	40	2.890	40
2.799	70	2.798	70	2.799	70
2.724	70	2.723	70	2.724	70
2.682	90	2.681	90	2.682	90
2.550	100	2.550	100	2.550	100
2.334	70	2.334	70	2.334	70
2.280	30	2.293	40	2.287	40
2.153	70	2.150	70	2.159	70
2.046	60	2.048	60	2.045	60
2.023	20	2.017	20	2.015	20
1.889	10	1.880	10	1.889	10
1.846	50	1.845	50	1.846	50
1.640	80	1.641	80	1.640	80
1.579	40	1.572	40	1.578	40
1.546	50	1.549	50	1.541	50
1.515	70	1.515	70	1.515	70
1.496	60	1.500	60	1.491	60
1.465	50	1.460	50	1.469	50
1.442	100	1.442	100	1.442	100

These results are satisfactory when compared with the data published by Serdjucenko (1954).

Partial chemical analyses were done spectrographically using an A.R.L. Quantometer. Synthetic standards were prepared and analyzed by mixing pure chemicals in approximately the same amounts expected in the natural samples of pargasite. From these known standards, the samples were analyzed in similar fashion. The standards and samples were prepared by fusion technique using lithium carbonate and boric acid. All the analyses were done in quadruplicate and the averages are given. The results are reported in Table 2.

TABLE 2. PARTIAL CHEMICAL ANALYSES AND OPTICAL PROPERTIES OF PARGASITES FROM S.E. MADAGASCAR

	1 Pargasite, Beampingaratra	2 Pargasite, Esira	3 Pargasite, Amboanemba
SiO_2	40.60%	43.00%	41.10%
Al_2O_3	13.52	11.65	13.70
TiO_2	0.36	0.72	0.36
Total Fe as Fe_2O_3	7.30	2.80	4.80
MnO	0.08	0.05	0.07
MgO	18.30	20.60	17.90
CaO	14.40	13.80	13.20
Na_2O	0.94	1.11	0.97
n_γ	1.669	1.642	1.651
n_α	1.650	1.624	1.631
δ	0.019	0.018	0.020
2V	70°(+)	58°(+)	66°(+)
$n_\gamma:z$	21°	26°	22°
D	3.175	3.130	3.160
Colour	Dark green-blue	Pale brown	Light grey-green

These pargasites are pale brown to dark greenish blue in colour. Their hardness is between 5 and 6 and their density, between 3.130 and 3.160. Their optical properties are also listed in Table 2 along with the partial chemical analyses. These results were found satisfactory when compared with the works of Serdjucenko (1954), Matsumoto (1954) and Gillberg (1959). The indices of refraction α, vary from 1.624 to 1.650, and γ, from 1.642 to 1.669. Birefringence varies from 0.018 to 0.020. The optic axial angles vary from 58° to 70° with a positive optic sign. The extinction angles vary between 21° and 26°.

Trace elements were determined spectrographically by the methods described by Black (1952) and Mitchell (1948) using Jobin et Yvon

TABLE 3. TRACE ELEMENTS IN PARGASITES FROM S.E. MADAGASCAR*

Element	1	2	3
B	20 ppm	820 ppm	25 ppm
Ba	270	90	410
Be	20	35	5
Co	75	65	65
Cr	90	345	110
Cu	85	100	75
Ga	20	30	15
Mn	1050	580	680
Ni	50	50	30
Pb	20	25	15
Sn	1625	220	10
Sr	1065	1665	190
Y	415	2700	370
Yb	10	10	5
Zn	185	410	200

*All of the analyses were done in triplicate and the average is given (except for sample 1, which was analysed 16 times).

TABLE 4. PRECISION DATA FOR SAMPLE 1

Element	*n*	Mean[1]	Relative Deviation[2]
SiO_2	16	40.60%	1.06%
Al_2O_3	16	13.52	8.13
Fe_2O_3	16	7.30	10.06
CaO	16	14.40	6.14
MgO	16	18.30	2.66
MnO	16	0.08	2.22
TiO_2	16	0.36	7.30
Na_2O	16	0.94	5.88
B	16	20 ppm	12.00%
Ba	16	270	8.60
Be	16	20	6.80
Co	16	75	8.10
Cr	16	90	10.40
Cu	16	85	3.80
Ga	16	20	14.19
Mn	16	1050	4.99
Ni	16	50	3.90
Pb	16	20	8.20
Sn	16	1625	15.24
Sr	16	1065	13.13
Y	16	415	8.50
Yb	16	10	9.80
Zn	16	185	10.50

[1]Bias-corrected mean of four determinations.
[2]Combined deviations of measurement and bias-correction, for single determinations.

quartz prism spectrograph. The measurements of line densities were made with the A.R.L. Spectroline Scanner. Samples and synthetic standards were mixed with graphite (1:1) using 0.02% La_2O_3 as an internal standard. A water-cooled Stallwood jet of CO_2 was used to improve precision. Johnson-Matthey 'Specpure' chemicals were used to prepare standards. The data obtained are given in Table 3.

Sample 1 was analyzed 16 times to determine the reproducibility and precision of the methods used. The results of this precision are given in Table 4.

The general high level of trace elements in the samples of pargasite confirm the very complex paragenesis of the minerals of S.E. Madagascar (phlogopite, uranothorianite, monazite, cassiterite, spinel, rutile, ilmenite, magnetite, garnets, zircon, sphene, beryl, apatite, pyroxenes, amphiboles, feldspars, calcite, dolomite, scapolites, saphirine and various sulphide minerals) (Lacroix, 1922, 1941; De La Roche, 1956, 1958).

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References

Black, I. A. (1952): Application of the seidel transformation to the determination of intensity ratio by blackening curve separation: *Spectrochim. Acta* **4**, 519–524.

De La Roche, H. (1956): La géologie de l'éxtrême Sud-Est de Madagascar: *Bull. Soc. Géol. France* (6) **6**, 259–267.

——— (1958): *Contribution à l'étude géologique du socle cristallin de Madagascar*: Thèse, Uni. de Nancy.

Gillberg, M. (1959): A lead-bearing variety of pargasite from Langban, Sweden: *Arkiv. Min. Geol.* **2**, 425–430.

Lacroix, A. (1922): Minéralogie de Madagascar, **I, II, III**, Challamel, Paris.

——— (1941): Les gisements de phlogopite de Madagascar et les pyroxénites qui les renferment: *Ann. Géol. Serv. Min. Madagascar* **XI**.

Matsumoto, H. (1954): Pargasite from Ishikami-yama on the outskirts of Kumamoto City: *Journ. Jap. Assoc. Min. Petr. Econ. Geol.* **38**, 26–30.

Mitchell, R. L. (1948): The spectrographic analysis of soils, plants and related materials: *Comm. Bur. Soil. Sci., Tech. Comm.* **44**, 1–183.

Serdjucenko, D. P. (1954): Pargasites from the Archean rocks of Southern Yakutia, Siberia: *Doklady Acad. Sci. U.S.S.R.* **96**, 1244–1236.