POLSKIE TOWARZYSTWO MINERALOGICZNE – PRACE SPECJALNE
MINERALOGICAL SOCIETY OF POLAND – SPECIAL PAPERS
Zeszyt 22, 2003; Volume 22, 2003

Roman WŁODYKA[1]

SPINEL MINERALS IN PICRITE ROCKS OF THE TESCHENITE-PICRITE FORMATION

INTRODUCTION

Evidences of the Mesozoic volcanic activity can be found in various geological units of the Western Carpathian. The Silesian Unit of the Western Carpathian Flysh Belt is a classic area of the teschenite-picrite association occurrence. Its geochemical pattern close to the interplate alkali rocks (Lucińska-Anczkiewicz, 2000).

Opaque oxides are present in all types of magmatic rocks occurring in this area (teschenite, diabase, picrite and lamprophyre). Spinel minerals in teschenite sills were investigated earlier by Harańczyk et al. (1971) and Hubicka-Ptasińska et al. (1971). Titanomagnetite, dominant opaque oxide in teschenite rocks, forms grains with size from less than 0.3 mm in the chilled marginal rocks to greater than 1 mm in the teschenites and syenoteschenites, and occurs as separate grains in felsic patches or as inclusions in diopside and kaersutite crystals. Characteristic feature of the teschenite sills is occurrence of an extensive subsolidus low-temperature oxidation of titanomagnetite. The titanomaghemite origin, metastable product of titaniferous magnetite oxidation has been discussed by Hubicka-Ptasińska et al. (1971).

There is no information on opaque oxides in other mentioned type of rocks, especially in picrite. In order to fill up this gap, the chemical composition of spinel minerals from picrite was determined by means of a CAMECA SX 100 electron microprobe.

RESULTS AND DISCUSSION

In the investigated picrite rocks oxides occur in two main textural forms. Small (<30 μm), Cr-rich spinels occur as inclusions, mainly in olivine and seldom in pyroxene. Euhedral octahedra of such spinels display composition changing from grain to grain with stable composition of individual grains ranging between between analyses no 1 and 2, presented in Table 1. These Cr-rich spinels are classified as aluminian chromite (Fig. 1, field A), using the terminology of Stevens (1944). Larger (>100 μm), anhedral grains occur as inclusions in

[1]*Faculty of Earth Sciences, University of Silesia, ul. Będzińska 60, 41-200 Sosnowiec, Poland*

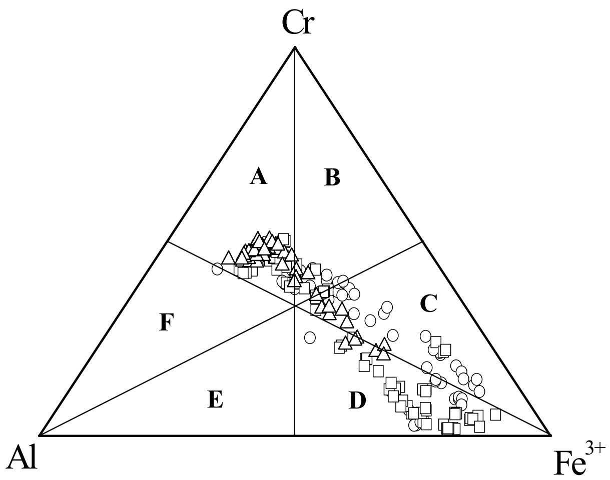

Fig. 1. Classification diagram of chromium-bearing spinels from picrite rocks (fields are divided according to Stevens, 1944: A-aluminian chromite, B-ferrian chromite, C-chromian magnetit, D-aluminian magnetite, E-ferrian spinel, F-chromian spinel). Symbols: open circles: Boguszowice 1; open squares: Cieszyn 2; up triangles: Boguszowice 19.

kaersutite or phlogopite. Chemical composition of these spinels varies strongly within a single grain (Table 1, an. 3 to 5 for sample Cieszyn 2 and an. 6 to 8 for sample Boguszowice 1). They have a diversified chemistry ranging from Al-rich chromite to Al/Cr-rich magnetite falling into segments A, B, C or D of the classification diagram (Fig. 1) along diagonal from the magnetite corner to the centre of the opposite side. Such variations of chemical composition correspond to a normal type of zoning observed in Cr-spinels (Fe-enrichment trend) during their crystallization. Toward their grain margins, Cr content gradually decreases while Fe content simultaneously increases. Ti first increases then decreases (Fig. 2; sample Cieszyn 2) or only slightly decrease (Fig. 2; sample Boguszowice1). The anhedral grains of oxides with grain size between 30-100 µm show the same, limited zoning patter with variations in chemistry between individual grains larger

Table 1. Chemical compositions of spinel minerals

	1	2	3	4	5	6	7	8	9
SiO_2	0.02	0.02	0.02	0.17	0.03	0.02	0.01	0.07	0.28
TiO_2	2.56	5.61	3.47	9.79	14.83	2.93	1.31	3.77	19.45
Al_2O_3	16.51	12.92	12.38	10.99	7.26	13.87	4.17	5.42	4.27
V_2O_3	0.26	0.32	0.23	0.04	0.07	0.23	0.24	0.41	0.09
Cr_2O_3	33.13	25.04	34.13	13.04	2.59	31.40	11.81	5.83	0.00
FeO*	34.89	43.22	38.53	54.27	62.99	40.91	74.37	75.22	70.70
MgO	9.08	8.35	8.59	8.44	7.64	7.24	2.19	2.94	0.45
CaO	0.01	0.04	0.02	0.00	0.10	0.00	0.00	0.00	0.00
MnO	0.28	0.30	0.14	0.36	0.45	0.53	0.38	0.43	0.95
NiO	0.10	0.30	0.12	0.07	0.14	0.12	0.08	0.09	-
Total	96.84	96.13	97.64	97.20	96.12	97.27	94.57	94.18	96.20

* total Fe as FeO

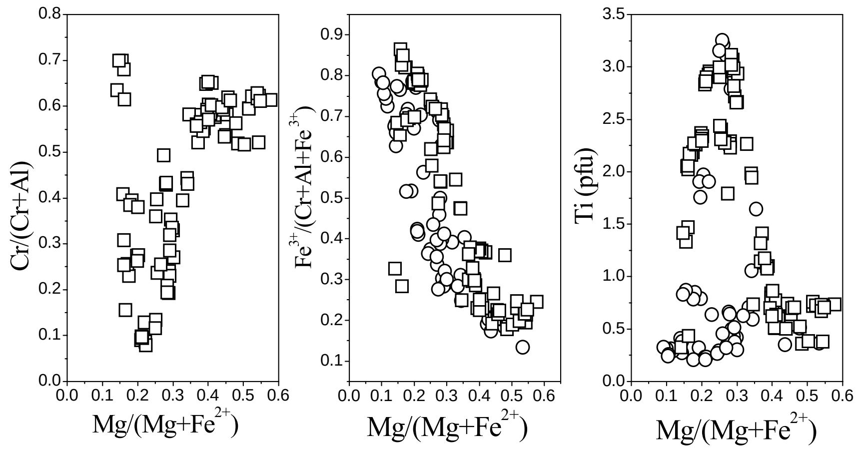

Fig. 2. Chromium-bearing spinel compositional data: symbols shown are those defined in Figure 1. The spinel analyses were recalculated on the basis of 32 oxygens and total iron was distributed between Fe^{2+} and Fe^{3+} in proportions required for spinel stoichiometry.

then within single grain. In general the investigated spinel minerals display complete solid solution between chromite and titaniferous magnetite. Oxygen fugacity is one of the most important factors controlling on the chromite-magnetite series compositions (Hill et all. 1974); at its value below 10^{-8} atm the crystallization of chromite is interrupted by clinopyroxen crystallization. Very similar zoning pattern was described for groundmass spinel from limburgites near Hohenstein (Kozłowski et al. 1988), for which crystallization temperature was estimated at 1360-1270^{o}C. In the other rocks (teschenite, diabase and lamprophyre) the titanomagnetite is dominant spinel minerals (an. 9, Table 1).

REFERENCES

HARAŃCZYK C., MAHMOOD A., NARĘBSKI W., 1971: Titanomaghemite in theralitic teschenite from Pastwiska near Cieszyn (Polish Carpathians). Bull. Acad. Pol. Sc., 19, 4, 223-231.

HILL R., ROEDER P., 1974: The crystallization of spinel from basaltic liquid as a function of oxygen fugacity. J. Geol. 82, 709-729.

HUBICKA-PTASIŃSKA M., JASIEŃSKA S., 1971: Electron microprobe studies on the transformation of titanomagnetite occurring in the Cieszyn Silesia Teschenites. Miner. Polon., 2, 15-25.

KOZŁOWSKI A., METZ P., 1988: Cr-Ti-Fe spinels in melt inclusions in olivines. Proceedings of the Seventh Quadrennial IAGOD Symposium, 213-224.

LUCIŃSKA-ANCZKIEWICZ A., 2000: New data on petrology of teschenite association rocks (Silesian Unit, Polish Western Carpathians) and chemistry of their clinopyroxenes. Miner. Polon., 31, 33-47.

STEVENS R. E., 1944: Composition of some chromites of the Western Hemisphere. Am. Miner. 29, 1-34.