New data on the nature of fine and ultrafine lamellae in titanomagnetite

NATALY I. KRASNOVA and YURI L. KREZER

1Department of Mineralogy, St. Petersburg University, University Quay 7/9, 199034 St. Petersburg, Russia

2Research Institute Mechanobr, Line 21, Building 8a, 199026 St. Petersburg, Russia

Abstract: Microtextural features and the chemical composition of intergrowths in titanomagnetite from various rocks have been investigated by scanning electron microscopy and energy-dispersive microanalysis on samples etched with concentrated HCl to allow the analysis of ultrathin (about 1 μm) lattice intergrowths. All intergrowths in titanomagnetite fall into the following groups: 1) ilmenite-geikielite; 2) spinel-magnetite and magnesian magnetite; 3) spinel-pleonaste; 4) spinel-hercynite. Compositional data are presented here for the first time for most of these intergrowths. Their nature has been confirmed in two specimens by X-ray diffraction studies on lamellar phases isolated from the titanomagnetite by repeated treatment with HCl and magnetic separation. These lamellar phases proved to be members of the ilmenite-geikielite group, in disagreement with the conventional opinion that they consist of ulvöspinel. Until now ulvöspinel has not been found in the lamellar intergrowth types in the studied titanomagnetites.

Some spinel and ilmenite inclusions developed as skeletal or isometric crystals, simultaneously with the growing magnetite grains; most inclusions, however, formed as a result of titanomagnetite exsolution at decreasing temperatures. The correct identification of the lamellar and other phases in titanomagnetite is only possible with a complex of up-to-date instrumental methods.

Key-words: titanomagnetite, ulvöspinel, oxide textures.

Introduction

The exsolution textures in titanomagnetite (Ti-Mt) have been described by many investigators (e.g. Ramdohr, 1980; Price, 1976; Haggerty, 1991). The lamellar exsolution textures consist mostly of ilmenite (Ilm-FeTiO₃), geikielite (Gk-MgTiO₃), pyrophanite (Py-MnTiO₃) and hercynite (Hc-FeAl₂O₄). The ultrathin cloth-like lattice intergrowths in some titanomagnetite specimens have been described as ulvöspinel, but there is no strong evidence in the literature to support this identification. Typical arguments for the existence of ulvöspinel as exsolved phase are the recalculation of total Ti-Mt analyses, the interpretation of Ti-Mt X-ray diffraction patterns, and some physical properties of Ti-Mt (Mogensen, 1946; Semenov, 1959; Vincent, 1960; Ramdohr, 1953). Electron microprobe analyses have also been reported, but unfortunately only for areas consisting of magnetite together with the cloth-like phase (Price, 1976, 1981). The pure ulvöspinel phase has never been extracted from the host magnetite, and direct investigations on these ultrathin intergrowths have rarely been carried out.

Boyarskaya & Gorshkov (1966) are in fact the only investigators who have produced X-ray microdiffraction patterns of a pure thin-latticed Ti-rich phase by dissolving the magnetite matrix from ultrathin sections in HCl for 30 seconds. The published microdiffraction patterns, how-