Crystallization sequence of minerals and origin of the Fe-Ti-V oxide ores from the Baima layered intrusion in the Panxi Area

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Abstract: A about 260 Ma aged Baima layered intrusion, located in the Panxi rift within the western margin of the Yangtze plate, is an important part of the Emeishan large igneous province (ELIP). It is a large mafic-ultramafic complex hosting a giant Fe-Ti-V oxide deposit. The ore-bearing intrusion is mainly composed of magnetite troctolite and olivine grabbro. The major industrial orebodies are hosted in the troctolite phase in lower part of the complex. and. Microscopic study of the mineral structure reveals that olivine and amphibole both have two different structural states, indicating the emplacement characteristics of multiple pulses of magma. The mineral textural features and EPMA analytical results of magnetite, ilmenite, olivine, amphibole, and plagioclase show that the inferred crystallization sequence is plagioclase + olivine + clinopyroxene → amphibole + magnetite + ilmenite → amphibole. According to compositions of amphibole and plagioclase, the calculated lowest crystallization temperature of amphibole is 1090 ℃, and the calculated highest crystallization temperature of plagioclase is 1120 ℃. It is inferred that the crystallization temperature of magnetite is from 1090 ℃ to 1120 ℃. Electron microprobe data indicate that forsterite percentages of olivine (Fo) are gradually decreased from the olivine in magnetite troctolite in the lower part to the olivine in olivine grabbro in the upper part of the complex. This indicates that the oxygen fugacity of the system varies gradually with the magmatic crystallization differentiation process, inferring the crystallization differentiation process of the magma occurred in a closed system. The V_2O_3 contents of the magnetite vary from 0.72% to 1.37%, indicating a relative low oxygen fugacity (<FMQ + 0.5) for the magma during its evolution process. The crystallization of large amounts of silicate minerals under such a low oxygen fugacity would results in the gradual increase of the oxygen fugacity and Fe contents in the residual melt. This could be the main reason why the immiscible melt and the Fe-Ti-rich were formed at the late stage of the magma.

Keywords: Vanadium-titanium magnetite; Metallogenesis; the Baima intrusion; the Panxi area in Sichuan; Emeishan large igneous province