

Geochemistry of the Panzhihua Mafic Layered Intrusion (SW China): Petrogenetic Implications for its Giant V-Ti-Magnetite Deposit

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The Panzhihua mafic layered intrusion in the western margin of the Yangtze Block, SW China, is one of the intrusions forming part of the Emeishan large igneous province. The Emeishan Flood basalts were derived from a mantle plume that also produced many feeders that are the hosts of major ore deposits including V-Ti-magnetite deposits (Zhong et al., 2002). The intrusions are dated at 260Ma and are contemporaneous with the Emeishan Flood volcanism (Zhou et al., 2002).

The Panzhihua V-Ti-magnetite-bearing intrusion dips generally 50°–60° NW and extends from NE to SW for about 19 Km. It is about 2000m thick and has an outcrop area of 30 km². The ore-bearing gabbro body approximately concordantly intruded Late Neoproterozoic dolomitic limestones (Fig. 1). The Panzhihua gabbro body is apparently a layered intrusion. From the bottom to the top, four zones are distinguished. A marginal zone consists of mainly fine-grained hornblende gabbro and olivine gabbro with thickness ranging from 0 to 40m. This zone is followed by a bottom ore-bearing layered melanogabbro zone mainly of magnetite-rich gabbro with thickness ranging from 0 to 110m. Upwards is the lower layered melanogabbro comprising chiefly clinopyroxene-rich gabbro, olivine gabbro, and some magnetite-rich gabbro with thickness ranging from 0 to 800m. On the top is the upper layered leucogabbro consisting mainly of plagioclase-rich gabbro. Mafic minerals, such as olivine and clinopyroxene dominate at the bottom part of each rhythmic unit, whereas felsic mineral such as plagioclase is enriched at the upper part. Gabbros are medium-grained and comprise about 65% plagioclase, 25–30% clinopyroxene, and 5% magnetite. Some of these rocks may contain hornblende up to 4%. Plagioclase and clinopyroxene with ilmenite exsolution lamellae are about 1–3mm large. The rock has subhedral clinopyroxene enclosed by anhedral hornblende (Fig. 2).

The rocks in the Panzhihua intrusion show more evolved compositions with increasing stratigraphic height within a unit. TiO₂ and Fe₂O₃ concentrations vary approximately from 0.5 to 9.2

% and 1.5 to 41% respectively. The concentration of Ti is greatest at the bottom part of the rhythmic unit I, and tends to decrease within the unit. Na₂O and K₂O tend to be more enriched in evolved magma and their contents vary from 1.4 to 4% and 0.01 to 0.45 respectively. Plagioclase crystals become more K- and Na-enriched upwards. MgO and FeO tends to decrease upward in each rhythmic unit. The chemical data suggest that upper part rocks in each unit are products of a more evolved magma than the lower part rocks.

The ore-rich cumulates contain about 200–600 ppm of V, 100–200 ppm of Ni. They are believed to be concentrated in the bottom part of each unit. Sr contents ranging from 50 to 1350 ppm increase with the increasing of MgO. In the chondrite-normalized diagrams, all rocks have chondrite-normalized REE patterns enriched in LREE but deplete in HREE.

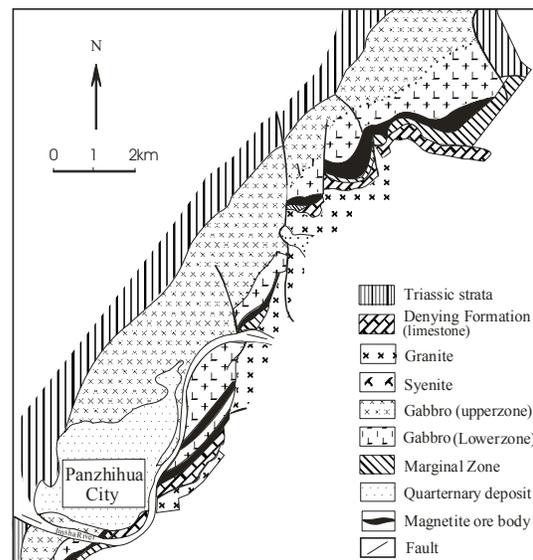


Figure 1. Geological map of the Panzhihua layered intrusion, SW China.

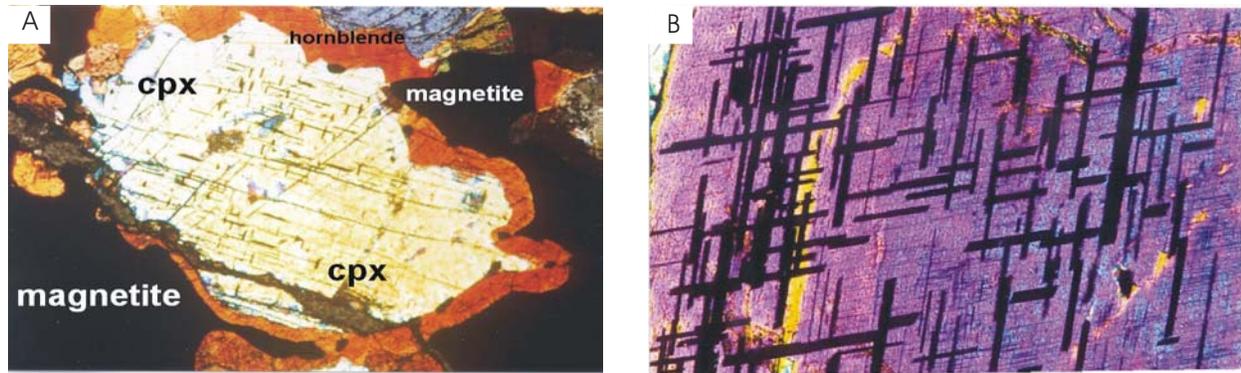


Figure 2. Microphotos of gabbros from the Panzihua intrusion: A) Hornblende rimming clinopyroxene. B) Clinopyroxene with ilmenite exsolution lamellae.

The parental magma was enriched in V and Ti, and had high water content. In order to have three rhythmic units, there should be at least three pulse of magma injections into the magma chamber. Following the crystallization of silicate minerals at the earlier stage, the V-Ti-magnetite crystallizes at the latest stage in a fluid-rich environment.

References

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