

A Triumvirate of Fe-Ti Oxide Ore-Bearing Gabbro-Granitoid Complexes in the Panxi Region of the Permian Emeishan Large Igneous Province, SW China

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The Late Permian (~260 Ma) Emeishan large igneous province of SW China contains three nearly identical gabbro-granitoid complexes which host giant Fe-Ti oxide deposits. The Fe-Ti oxide deposits are within the lower portions of evolved layered gabbroic intrusions which are spatially and temporally associated with A-type granitic plutons. The 264 ± 3 Ma Taihe layered gabbroic intrusion hosts a large magmatic Fe-Ti oxide deposit and is coeval with the Taihe peralkaline A-type granitic pluton which is dated at 261 ± 2 Ma. Within the A-type granitic pluton are microgranular enclaves which have compositions intermediate between the gabbro and host granite. Primitive mantle normalized incompatible element plots show corresponding reciprocal patterns between the mafic and felsic rocks. The chondrite normalized REE patterns show Eu-anomalies changing from positive ($\text{Eu}/\text{Eu}^* = 1.5$ to 2.2) in the gabbroic intrusion, to negative in the enclaves ($\text{Eu}/\text{Eu}^* = 0.4$ to 0.6) and granites ($\text{Eu}/\text{Eu}^* = 0.2$ to 0.5). Whole rock $\epsilon\text{Nd}(\text{T})$ values of the gabbroic intrusion ($\epsilon\text{Nd}(\text{T}) = +2.5$ to $+3.3$) are similar to the enclaves ($\epsilon\text{Nd}(\text{T}) = +1.0$ to 2.0) and granite ($\epsilon\text{Nd}(\text{T}) = +1.5$ to $+1.9$) whereas the zircon $\epsilon\text{Hf}(\text{T})$ values of the gabbro ($\epsilon\text{Hf}(\text{T}) = +8.9 \pm 0.6$) are indistinguishable from the granites ($\epsilon\text{Hf}(\text{T}) = +9.2 \pm 1.0$), suggesting that all rock types originated from the same mantle source. Geochemical modeling indicates that the gabbros and granites can be generated by fractional crystallization of a common parental magma similar to high-Ti Emeishan flood basalt. The compositional jump from the gabbro to the enclaves is attributed to the crystallization of the Fe-Ti oxide minerals. The results of this study and previous studies suggest that the magmatic conditions (e.g. pressure, composition, $f\text{O}_2$) which lead to the formation of at least three Fe-Ti oxide bearing gabbro-granitoid complexes were relatively common during the development of the Emeishan large igneous province.

Keywords: Permian; Fe-Ti oxide deposit; A-type granite; enclaves; layered gabbro; Emeishan large igneous province; fractional crystallization; MELTS