Origin of the Youmapo granitic complex and implications for the polymetallic mineralization

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Voluminous granitic complexes were emplaced in the Late Mesozoic in South China, accompanied by large-scale W-Sn polymetallic deposits. Traditionally, the late-stage intrusion of a granitic complex was considered to be residual melts through fractionation of the main-phase intrusion, and polymetallic deposits from a common magma. Here we study the ages, geochemistry and Nd isotopes of the Youmapo complex from South China, and propose a different model for the origin of the granitic complex and related polymetallic mineralization.

The Youmapo granite is a typical composite pluton with main-phase granodiorite and highly differentiated muscovite-granite. Zircon U-Pb dating shows that the muscovite-granite formed at 100.7±0.5 Ma, which is significantly younger than that of the granodiorite (109.0±0.3 Ma). Other evidence further preclude the co-magmatic evolution for the two intrusions: (1) Hornblende, titanite and magnetite appear in the granodiorite, suggesting water-rich and high fO_2 features, which is different from the fluorine-rich and low fO_2 features for the muscovite-granite as indicated by the presence of fluorite and ilmenite. (2) Zircons from the muscovite-granite are characterized by extremely high U contents (10602×10^{-6}), and contain microfractures caused probably by radioactive damage, while zircons from the granodiorite have low U contents (860×10^{-6}). (3) The muscovite-granite has quite high concentrations of W and Sn, with REE tetrad effect and non-CHARAC behavior, while the main-phase granodiorite shows features of normal granites. (4) Nd isotopic compositions of the granodiorite ($\varepsilon_{Nd}(t)$ = -5.1~-4.0) are also different from that of the muscovite-granite ($\varepsilon_{Nd}(t)$ = -9.6~-8.6).

Therefore, we conclude that the late-stage muscovite-granite probably formed through a new partial melting event, not derivatives of the granodiorite by fractionation. High fluorine lowered the solidus temperature and viscosity of granite magma. Fluorine-rich highly differentiated magmas extracted ore-forming metals from the source and country rocks, and finally formed the polymetallic deposits in the shallow crust.