Indosinian Magmatic Activity and Formation of the Muguayuan Porphyry-Type Tungsten Deposit, Hunan Province, China

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The Muguayuan porphyry-type tungsten deposit, Taojiang County, Hunan Province, is located in the middle of an ancient arc basin system along the southeastern margin of the Upper Yangtze block. The Sanxiaba ore-bearing granite porphyry, outcropping in an area approximately 200 m by 50 m, is strongly altered, mainly characterized by sericitization, silicification, greisenization, pyritization, and chloritization. The tungsten orebodies are mainly hosted in the granite porphyry. The ore-related minerals, such as scheelite, molybdenite, and pyrite, are disseminated in the granite porphyry and closely related to the silicification. The LA-ICP-MS zircon U-Pb dating of the Sanxianba granite porphyry yielded weighted average $^{206}Pb/^{238}U$ ages of 224.2 + 1.7 Ma (MSWD=2.6, N=17), showing magmatism occurred during the Late Triassic Indosinian intracontinental orogen in the South China block. The initial ratios of $^{176}Hf/^{177}Hf$ values, εHf(t), and two stage model ages (tDM2) of zircons for the porphyry are 0.282444 ~ 0.282580, -1.9 ~ -7.2, and 1388 ~ 1713 Ma, respectively. In the εHf(t)-t and $^{176}Hf/^{177}Hf$-t plots, those samples are falling on the lower crust area that is below the evolution line of chondrite. The Hf isotopic data indicate that the magma source for the Sanxianba granite porphyry is mainly Paleoproterozoic to Mesoproterozoic ancient crustal rocks, with almost no mantle component involved. The Indosinian W-Sn deposits of south China, such as Hehuaping, Liguifu, Maling, and Jiepai, also all show a genetic relationship with Indosinian magmatic activity. Theories on the genesis of Indosinian magmatic activity in south China include the following: (1) the result of plume-derived mantle magma and crustal melting magma mixing; (2) an association with the subduction of the paleo-Pacific plate; (3) intracontinental orogeny of different blocks comprising the South China craton, with the limited influence by the surrounding plate boundaries; and (4) plate convergence and extension related to collision of Sibumasu and Indo-South China at ca. 258 ~ 243 Ma, and the possibly coeval western movement of the paleo-Pacific plate and collision of North China and South China cratons. We favor the concept that the Paleoproterozoic to Mesoproterozoic ancient lower crust was melted during intracontinental orogeny, and the granitic magmas carried the ore elements (W, Sn, Mo) to the shallow crust, with the metals enriched in the magmatic-hydrothermal fluids to form the ore deposits. With the discovery of additional Indosinian magmatic rocks in south China, the potential for discovery of W-Sn-Mo polymetallic deposits related to the granitic magmatic rocks remains high.