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Geological Characteristics and Geochronology of Pangushan Tungsten Deposit in Jiangxi Province, China

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Pangushan tungsten deposit is one of the four well known mountainous tungsten deposits (Pangushan, Xihuashan, Kuimeishan and Dajishan tungsten deposits) in South Jiangxi Province. It was a large-scale deposit discovered in 1918 and open-pit mining commenced in 1922.

Pangushan tungsten deposit is located in the intersection of NE-SW trending Pangushan-Tieshanlong tectono-magmatic-metallogenic zone and S-N trending Pangushan-Shangping tectonic zone. The strata in the deposit comprise the exposed Upper Devonian Zhongpeng Formation terrigenous clastic rocks made up of coarse- to fine-grained sandstone and siltstone with a few beds bearing gravels and covered Sinian-Cambrian basement below 200 m elevation consisting of low-grade metamorphic sandstone, slate, carbonaceous slate and phyllite. They are both main hosts to the ore-bearing quartz veins. The deposit occurs within a location of complex structure. The basement supracrustals formed compact and even inverse folds with NNW-SSE axial trending and steep limbs whereas Upper Devonian was shaped into axially NNW-NW trending folds with gentle limbs. These folds are intersected by steep (60°-85°) faults striking NEE-SWW, NNW-SSE and E-W and characterized by ever multistage activities. Of the three groups, NEE-SWW striking faults (especially F5) exert most evidently influence on mineralization. They had undergone extension and laevorotation before mineralization in favor of formation of E-W and NNW-SEE trending post-ore structures appearing like "X". No plutons are exposed on the surface, but buried Early

Yanshanian granitic pluton was discovered at -115 m elevation by a previous exploration drilling and at -340 m elevation by 2000 m Nanling Scientific Drilling (SP-NLSD-2) recently. The pluton comprises grayish white fine-grained muscovite granite featuring greisenization and albitization at the top of the pluton and flesh red medium- to fine-grained biotite granite characterized by remarkable potash feldspathization below the former. Muscovite granite is composed mainly of 40~50% quartz, 30~35% plagioclase, 5~10% K-feldspar and 5~7% mica and biotite granite comprises 25~35% quartz, 5~10% plagioclase, 50~60% K-feldspar and 3~5% mica.

The deposit presents mineralization in the form of thick (0.2~2 m thick) ore-bearing quartz veins, with a mineralized area of 1.2 km² and more than 70 economic veins steeply dipping south at 65°-88°. Most of the ore-bearing quartz veins fill the "X"-like extensional second-order fissure system composed of conjugated E-W trending fissures and NNW-SEE trending fissures developed in Sinian-Cambrian basement and Upper Devonian. NNW-SEE trending quartz veins are much prevalent than the E-W trending ones. Spatially distributed, all of quartz veins are generally subdivided into southern group, central group and northern group with the southern group being predominant both in scale and in vein quantity. Towards north from south, the vein dips change from gentle to steep and vein length both along strike and down-dip turns greater, which makes them broom-like generally. The northern group with individual ore vein 200-450 m long can be traced to 535 m elevation, and the central one with individual ore vein 200-500 m long can be traced to 385 m elevation, while the southern

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one with individual ore vein 100-1000 m long intersect the buried granite. Ore veins usually display an undulating form along strike or downdip and they branch and intersect, swell and shrink and pinch-out with an echelon arrangement commonly observed. In the deposit, the major ore minerals comprise wolframite, molybdenite, bismuthinite, scheelite, cassiterite, pyrite, chalcopyrite, galena, quartz, feldspar, fluorite and others. W is concentrated in the form of wolframite in the upper part of deposit, whereas scheelite tends to be increased downward, accompanied by more sulfides. The deposit enjoys grades averaging 1.397% WO_3 and 0.24% Bi as well as high content of Mo, Cu, Pb and Ag. Unlike other tungsten deposits, Pangushan deposit is enriched in Te mainly distributed within sulfides, especially bismuthinite. The grade of WO_3 shows a low-high-medium zoning measured from the surface to exocontact of concealed granite, while those of Bi and Mo get higher. Silicification, greisenization, muscovization, sericitization, biotization, chloritization, carbonatization and pyritization are observed in the deposit. Of these, greisenization, muscovization, secondary silicification and biotization are intimately associated with the tungsten mineralization.

Being mined in the past 90 years, Pangushan tungsten deposit becomes crisis in resource at present. In order to acquire an understanding of its diagenesis and mineralization as well as corresponding tectonic setting,

and thus further ore prospecting, the ages of the concealed medium- to fine-grained biotite granite and mineralized veins both sampled from core of SP-NLSD-2 arranged at southern part of the deposit were determined by LA-ICP-MS zircon U-Pb and ICP-MS Re-Os isotopic methods, respectively. The determination has yielded the ages of (161.7 $\pm$ 1.6) Ma from weighted average of $^{206}\text{Pb}/^{238}\text{U}$ ages of magmatic zircons and (152.0 $\pm$ 2.6) - (155.9 $\pm$ 3.1) Ma of molybdenite. These results indicate that the mineralization in Pangushan tungsten deposit was 5-10 Ma later than the diagenesis. The mineralized veins in southern deposit were produced during large-scale mineralization in Nanling region, which shows their excellent ore-prospecting potential. Molybdenites have quite low Re contents, suggesting continental crustal provenance of the ore metals with little mantle substance mixed. Pangushan area had experienced the Early Yanshanian magmatism-mineralization corresponding to the extension-thinning of lithosphere and widespread Mesozoic metallogenic event during (165-150) Ma in South China.

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