Muscovite $^{40}Ar/^{39}Ar$ Dating of the Tiantangshan Sn Deposit in Nanling Region, South China

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The Nanling region in the South China hosts the largest concentration of W-Sn deposits in China (Mao et al., 2007). Recently, Triassic and Cretaceous mineralization events have been recognized in the Nanling region, which are considered to be associated with late-collisional or post-collisional processes (Hua et al., 2005a; Mao et al., 2008, 2013; Zhou et al., 2006) and the subduction of the Paleo-Pacific plate (Mao et al., 2013), respectively. The Tiantangshan Sn deposit, located in the easternmost Nanling region, is a newly discovered large-scale Sn deposit. However, it is currently unclear whether Sn mineralization is genetically related to Triassic or Cretaceous magmatism. In this study, we present new geochronological data for the Tiantangshan deposit in order to constrain genesis of the deposit.

Most of orebodies at Tiantangshan occur along contacts between quartz porphyry and volcanic rock. Mineral assemblage studies show that the hydrothermal muscovite coexists with cassiterite at Tiantangshan, indicating that the age of muscovite can well constrain the formation of Sn mineralization. Therefore, we conducted muscovite $^{40}Ar/^{39}Ar$ dating of associated tin ore samples from the Tiantangshan deposit. The result shows that the hydrothermal muscovite has the plateau $^{40}Ar/^{39}Ar$ age of 133 ± 1 Ma, representing the timing of Sn mineralization. This age is consistent (within error) with the zircon SHRIMP U-Pb age (137 ± 2 Ma; unpublished data) for the Tiantangshan quartz porphyry, suggesting that crystallization of the quartz porphyry and initiation of Sn mineralization are temporally related. Consequently, all these evidences indicate that Sn mineralization is spatially, temporally, and genetically associated with Cretaceous quartz porphyry at Tiantangshan.

Mesozoic W-Sn and rare metal deposits in South China can be divided into three distinct episodes (Mao et al., 2013): (1) Late Triassic W-Sn-Nb-Ta mineralization (230–210 Ma); (2) Late Jurassic polymetallic W-Sn mineralization (160–150 Ma); and (3) the Cretaceous polymetallic Sn-W mineralization (134–80 Ma). Many studies indicate that the subduction direction of the Paleo-Pacific plate changes from oblique subduction to parallel with respect to the continental margin at 135 to 80 Ma, which leads to large-scale lithospheric thinning and asthenospheric upwelling (e.g., Meng et al., 2012; Mao et al., 2013; Yuan et al., 2015; Zheng et al., 2017). This is also supported by the fact that Cretaceous mafic dikes, pull-apart basins, volcanic basins, and metamorphic core complexes extensively developed in South China (Faure, 1998; Faure et al., 1996; Gilder et al., 1991; Yu et al., 2005). Our new muscovite $^{40}Ar/^{39}Ar$ dating shows that the Tiantangshan deposit formed at 133 ± 1 Ma, indistinguishable from zircon U-Pb age for the quartz porphyry. This indicates that both quartz porphyry and associated Sn mineralization at Tiantangshan were associated with lithosphere thinning induced by asthenosphere upwelling during the Cretaceous.