Direct dating of wolframite by $^{40}Ar/^{39}Ar$ progressive crushing

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Directly dating the ore minerals is the most potential way to precisely determine the mineralization ages of deposits. In order to investige the possibility of dating wolframite directly by $^{40}Ar/^{39}Ar$ progessive crushing, the paragenous wolframite and biotite were separated from a hand specimen 09ZB05 from the Xialong tungsten deposit, and three K-feldspars were selected from small Kfs veins in the Piaotang tungsten deposit, 13 kilometers away from the Xialong deposit.

The biotite and K-feldspars by laser stepwise heating yield flat age spectra. The biotite obtains concordant plateau and isochron age of 152.0 ± 0.8 Ma (1σ), and three Kfs plateau ages are 83.0, 82.2, and 82.3 Ma with errors of 0.4 Ma, respectively.

The $^{40}Ar/^{39}Ar$ dating result of wolframite by crushing forms a declining age spectrum marked by abnormal old apparent age at the first stage, then the apparent ages decline step-by-step, and finally a plateau appears with an age of 150.5 ± 1.2 Ma in the last 7 stages (about 54.4% of the total ^{39}Ar). On the inverse isochron diagram the data points of the wolframite clearly distribute into two groups corresponding to secondary and primary fluid inclusions. The secondary ones contain excess ^{40}Ar and their data points define isochron line with initial $^{40}Ar/^{36}Ar$ ratio of 486.7, higher than the ratio of the modern atmosphere, corresponding to age of 83.4 ± 5.9 Ma (MSWD = 0.04), concordant with the ages of the K-feldspars veins. The primary ones do not contain excess ^{40}Ar and their data points yield a well-defined isochron line with age of 150.7 ± 2.5 Ma (MSWD = 0.02) concordant with the age of the paragenous biotite by stepwise heating, indicating that mineralization occurred at ~150 Ma, coeval to the Late Jurassic large scale tin-tungsten mineralizations in South China. Thus the age of ~80 Ma should respresent a hydrothermal pulse far after mineralization.

This study reveals that wolframite is a suitable mineral for $^{40}Ar/^{39}Ar$ stepwise crushing, we expect progressive crushing technique will become an effective approach to determine the ages of geofluids.