Ar-Ar chronology study of the Qiugemingtashi-Huangshan ductile shear zone, Xinjiang, NW China

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The Qiugemingtashi-Huangshan ductile shear zone, situated in the middle Tianshan orogenic belt, Xinjiang, NW China, is believed to be the product of the subduction and collision of the two plates in the north and south of the East Tianshan during the late Paleozoic. It is the important part of the orogenic belt and also an important metallogenic belt, containing copper, nickel and gold deposit. According to the involved ductile deformed strata and Rb-Sr and K-Ar dating results, the shear zone age is inferred to be the late Carboniferous to the early Permian by the former researcher. Obviously, this is too extensive and we need further study. We use $^{40}Ar/^{39}Ar$ method, which is the most suitable method to date the shear deformation age, to date the Qiugemingtashi-Huangshan ductile shear zone and define the age of the early nappe shearing and the late strike-slip shear deformation.

Ar-Ar isotope chronology study reveals that the activity of Qiugemingtashi-Huangshan ductile shear zone show different time in the different area of the shear zone. In the early, the shear zone show nappe shearing and its upper limit on the age is 280Ma. In the late, it shows strike-slip shear deformation. In the Kanggur, situated in the middle-western shear zone, the $^{40}Ar/^{39}Ar$ age of the mylonites is mainly ~260Ma while in the southern Tuwu, situated in its east, the $^{40}Ar/^{39}Ar$ age of the mylonites is mainly 240-250Ma. Because the metal deposits of the East Tianshan are mostly located in this shear zone, the above results not only deepen the study on the tectonic history of the East Tianshan but also provide new age evidence for the further understanding the controlling of the shear deformation on the mineralization.

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Laser-ablation ICP-MS zonation-dependent α-ejection correction of zircons in (U-Th)/He chronometry

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We use LA-ICP-MS depth profiling of standards and zoned zircon samples together with a new LabVIEW-based numerical model to examine whether U-Th zonation is responsible for overdispersion and age bias observed in some (U-Th)/He data sets. Our model uses integration over 3-D matrix with isotropic grid spacing to determine zonation-dependent bulk retentivty, F_{ZAC}, as the relative-α-productivity-weighted average of local α-retentivity values. Integration occurs over three spatial dimensions and all relevant α-producing isotopes. Modeling of bipyramidal prisms with synthetic, geologically realistic zonation demonstrates that crystal morphology and zonation can conspire to create >30% α-ejection-corrected age bias when homogeneity and simplified geometries are assumed *a priori*.

In practice, our approach uses laser-ablation ICP-MS depth profiling on whole, unmodified zircons in grain-mount. Internal fragments of Sri Lankan detrital zircons are used as external concentration standards, and to monitor depth-dependent Th/Zr and U/Zr fractionation. Fractionation-corrected data for unknowns are used in the zonation-dependent bulk retentivity model to populate 3-D α-productivity matrices assuming self-similar crystal growth.

Results from two analytical systems are compared: 1) New-Wave 193 nm excimer laser– Element2 magnetic sector ICP-MS (Yale); and 2) Merchantek 213 nm Nd:YAG laser – VG PQ ExCell quadropole ICP-MS (BU). Reproducibility of unbiased ages from un-zoned Fish Canyon Tuff zircon standards with multiple depth profiles indicate that helium is not quantitatively lost from the remaining volume during laser ablation. This method can be used to pre-screen candidate aliquots to identify homogeneous grains, or to calculate customized F_{ZAC} α-ejection corrections for zoned grains. A demonstrably un-zoned Tardree Rhyolite zircon produces a homogeneous α-ejection corrected age of 59.7 ± 4.8 (2σ) Ma in agreement with the accepted emplacement age of 58.4 ± 0.7 Ma, whereas the F_{ZAC} α-ejection correction for a Tardree zircon with a factor of ~40 U-depleted rim, yields an F_{ZAC}-corrected age of 57.8 ± 4.6 Ma (2σ) compared with a F_T-corrected age of 64.5 Ma assuming U-Th homogeneity.