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Detrital zircon ages from metasediments of the Kyrgyz Tianshan and significance for the Evolution of the Central Asian Orogenic Belt

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The Tianshan Mountains of Kyrgyzstan belong to the Central Asian Orogenic Belt (CAOB) which evolved over some 800 Ma from the late Mesoproterozoic to the late Palaeozoic through accretion of island arcs and microcontinents in the Palaeo-Asian Ocean. Unlike other parts of the CAOB which contain voluminous juvenile arc associations, the Kyrgyz North and Middle Tianshan are characterized by a predominance of magmatic rocks derived from melting of Precambrian crust. Early Palaeozoic magmatic associations are tectonically juxtaposed against Neoproterozoic to late Mesoproterozoic (Grenville-age) basement terranes, suggested to represent rifted fragments of the Tarim craton (1,2). We report LA-ICP-MS detrital zircon ages from clastic metasediments of the Kyrgyz North and Middle Tienshan to augment data from Mongolia (3) and try to identify possible source terranes. The detrital zircon record identifies two types of sediment, one is arc-derived and contains exclusively Palaeozoic zircons and is thus able to constrain the ages of the arcs from which they are derived. The other type predominantly records Precambrian sources and is either reflecting the input of detritus from nearby Precambrian continental fragments or from a cratonic terrain. Some samples also show mixed zircon populations reflecting input from both arc and continental sources. Some metasediments previously interpreted as Precambrian in age are, in fact, early Palaeozoic.

Examples of arc-derived sediments are a greenish sandstone from SW of Lake Issykul in the North Tianshan (KG50G) where 36 analyses of near-idiomorphic zircons are tightly grouped and yielded a well-defined Concordia age of 493±2 Ma. A chlorite schist from the Semizsay Metamorphic Complex in the Middle Tianshan (KG97) records a similar tight grouping of 36 zircon ages with a mean of 461±1 Ma. Other arc-derived metasediments show the arc signature by well-grouped early Palaeozoic ages but also contain much older zircons thus reflecting input from nearby Precambrian sources. For example, zircons from a two-mica-feldspar schist, also from the Semizsay Metamorphic Complex in the Middle Tianshan (KG104), exhibit a well-defined age cluster at 470 Ma but also record ages of ca. 1100, 1500, 1600, 1700 and 1850 Ma. A volcanic-derived sandstone in the Tyu-Ashuu pass (KG73) predominantly contains ca. 470 Ma zircons, but there are also grains up to 1820 Ma in age. There are also sediments reflecting derivation from a Neoproterozoic source such as recently identified in the North Tianshan (1). Thus, zircons from two sandstones from the Karatau-Talas Zone (KG109, 110) define excellent clusters at ca. 850 Ma but also record a few older ages up to 2.75 Ga.

Several of our dated metasediments are obviously derived from a Precambrian source since they contain no Palaeozoic zircons. This either reflects the close proximity of Precambrian crustal terranes (microcontinent?) or a nearby cratonic block. A good example is a sandstone from east of the town of Talas where the youngest grain is ca. 1160 Ma; there is an age cluster at ca. 1900 Ma, and there are a few grains as old as 2.9 Ga. A similar sandstone from the Makbal Complex north of Talas (KG76) contains zircons that span the entire range from ca. 1720 to 3000 Ma with one grain at ca. 3780 Ma, by far the oldest detrital zircon ever found in the entire CAOB.

Our detrital zircon record supports the contention that the Kyrgyz Tianshan shows little evidence of juvenile crust and mainly consists of reworked older crustal material. A comparison with the detrital zircon age pattern from Mongolia (3) shows similarities but also differences, and we consider it most likely that the Tarim craton supplied most of the Precambrian detritus as seen in the Kyrgyz detrital zircon age spectrum.

References

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(2) Kröner et al., 2012. Gondwana Res., in press.
(3) Rojas-Agramonte et al., 2010. Gondwana Res. 19, 751-763.