Geophysical Research Abstracts
Vol. 18, EGU2016-1512, 2016
EGU General Assembly 2016

Tectonic evolution of the East Junggar terrane, CAOB

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The East Junggar terrane is one of the important tectonic units of the Central Asian Orogenic Belt (CAOB; Zonenshain et al., 1990). Debate surrounds the tectonics of the East Junggar area, including tectonic setting, age, basement nature, subduction polarity and collisional time between the East Junggar terrane and Junggar block (e.g., Xiao et al., 2008, 2011; Long et al., 2012; Huang et al., 2012). Among the two popular models, one suggests that the Junggar is a continental block (e.g. Zhang et al., 1984, 1993; Watson et al., 1987; Xiao et al., 1992; He et al., 1994; Li et al., 2000; Charvet et al., 2001, 2007; Xu et al., 2003; Zhao et al., 2003; Buslov et al., 2004; Xu and Ma, 2004; Dong et al., 2009; Bazhenov et al., 2012; Choulet et al., 2012; Zhang et al., 2012). The other model proposes that the Junggar has a basement of Paleozoic oceanic crust (e.g., Carroll et al., 1990; Zheng et al., 2007) or oceanic island arc complexes (e.g., Coleman, 1989; Chen and Jahn, 2004; Windley et al., 2007) of the Altaid Paleozoic rocks (e.g., Sengör et al., 1993; Sengör and Natal'in, 1996; Allen and Vincent, 1997; Filippova et al., 2001; Xiao et al., 2004a, 2004b, 2008, 2009, 2010a, 2010b, 2012). The tectonics in the Eastern Junggar area are interpreted to be related to late Paleozoic intra-oceanic accretion induced by northward subduction of the Junggar oceanic lithosphere (e.g. Xiao et al., 2008, 2009; Biske and Seltmann, 2010; Wan et al., 2011; Yang et al., 2011) or by the southward subduction of the Paleo-Asian oceanic lithosphere (Zhang et al., 2004; Wong et al., 2010; Su et al., 2012).

Recently, we did detailed field survey and petrological, geochemical and chronological analysis of the metamorphosed volcanic rocks and magmatic rocks, and new discovered gneiss and magnetite quartzite enclaves from the Taheir tectonic window in the East Junggar region which is situated between the Zaisan–Erqis–the Main Mongolian Lineament-suture and the Kelameili suture. The new results reveal the following evidence:

1) The dioritic gneiss was metamorphosed from 2.52 Ga diorite at approximately 1.88 Ga, the magnetite quartzite interlayered with hornblende–plagioclase gneiss layers has an age of approximately 1.92 Ga, and the inherited zircons from the diorite TH4-6 contain three zircon populations with upper interceptages of approximately 3.06 Ga, 1.98 Ga and 1.89 Ga. These data indicate that the East Junggar terrane has Archean crust that formed at approximately 3.2–3.0 Ga and includes 2.52 Ga diorites and 4.0 Ga zircons and materials.

2) The Taheir tectonic window consists of metamorphic and deformed Ordovician volcanic rocks and granitic porphyries, Ordovician–Silurian granites and undeformed Silurian–Devonian granitic diorite, diorites and rhyolitic porphyries. The Ordovician volcanic rocks and granitic porphyries and Ordovician–Silurian granites in the Taheir tectonic window exhibit distinct features of Andean-type continental arc, such as enrichment in Pb, K and U, depletion in Nb, P and Ti, negative Eu anomalies, high La/Yb, Th/Yb and Ta/Yb values, a high proportion of dacite, rhyolite and andesite of the calc-alkaline series, massive contemporary granitic intrusions, mixtures of the juvenile material and >2.5 Ga crust, and extensive crystallization differentiation. These Ordovician volcanic rocks witnessed a series of tectonic events, including burial associated with the intrusion of 454–449 Ma granitic porphyries, underthrusting and subsidence to a depth in the middle crust associated with the intrusion of 443–432 Ma granites. The formation of albite–hornblende schists, hornblende–albite–quartz leptynites and amphibolites, the transformation from continental to continental island arc at approximately 432 Ma, the exhumation associated with the intrusion of 416–406 Ma diorites with geochemical signatures of continental island arc, and exhumation and erosion between 398 Ma and 390 Ma are also identified. The arc types that are associated with the Taheir tectonic window and its host, the Yemaquan magmatic arc, changed from Andean-type continental arc to continental island arc after the intra-arc rifting that began at 432 Ma.

Moreover, we found mafic layered intrusions, a syn-collisional quartz diorite, andesitic tuffs overlying the ophiolitic melange, a late-collisional granodiorite and a post-collisional granitic porphyry in the Zhifang ophiolite belt between the East Junggar terrane and Junggar block. Our new SIMS zircon U–Pb data suggest that the West Hill ophiolitic melange in the Zhifang area contains segments of the 371 Ma MORB-type layered rocks and 363 Ma oceanic islands, which were intruded by the 348 Ma syn-collisional quartz diorites. The ophiolitic melange and 348 Ma syn-collisional quartz diorites are overlain by the 342 Ma andesitic tuffs. The 342 Ma andesitic tuffs and successive 332 Ma granodiorites-gabbro were formed at late-collisional setting, whereas the 314 Ma granitic porphyry at post-collisional setting. We suggest that the Junggar Ocean in the Zhifang area was opened before

371 Ma and 363 Ma, and possibly closed before 348 Ma. Collision between the East Junggar terrane and Junggar block occurred at 343–348 Ma in the Kalamaili–Zhifang area, the 344 Ma Hongliuxia ductile shear zone (Wu et al., 2012) was formed at syn-collisional process.

On the basis of the new evidence, the tectonic regime of the East Junggar terrane is redefined and a new model is proposed. It is suggested that the East Junggar terrane is related to the southward subduction of the Paleo-Asian ocean plate beneath the Junggar continent in the early Paleozoic and later shift to intra-oceanic subduction. Collision between the East Junggar terrane and Junggar block occurred at 343–348 Ma.