Geophysical Research Abstracts
Vol. 12, EGU2010-10098, 2010
EGU General Assembly 2010

Paleozoic to Jurassic terrane accretion along the northeastern margin of Tibet plateau

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The Tibet plateau is considered to have been constructed by a number of basement terranes accreted to the Eurasian margin during Paleozoic to Mesozoic times, and accretion is interpreted to have progressed southwards. The northern margin, exposed in Altyn and Qilian Mountains, is generally considered as an Lower Paleozoic orogen including previously subducted ultra-high successions (Yin and Harrison, 2000; Xiao et al., 2009). Previous tectonic models of the Qaidam block and adjacent mountain ranges at the northeastern margin of the Tibet plateau assumed a minor role of Indosinian tectonism in that region, and firm evidence was only reported from eastern Kunlun Mountains (e.g., Liu et al., 2005). Based on four sources of new data, we propose that the Indosinian tectonism was much more widespread in the northeastern Qaidam block and adjacent mountain ranges, Altyn and Qilian Mts., as believed before and we propose a new tectonic model. The new data sources comprise: (1) 40Ar/39Ar dating of detrital white mica of Jurassic to Pliocene sandstones from the north-eastern Qaidam basin fill; (2) interpretation of Ordovician, Devonian and Jurassic sedimentary successions, from which we interpret the Jurassic successions as intramontane molasse to the Indosinian orogen; (3) 40Ar/39Ar dating of detrital white mica in recent rivers from the southern Qilian Shan revealing possible basement sources in the Qilian Shan draining towards the Qaidam basin; and (4) structural study of basement rocks and subordinate 40Ar/39Ar mineral ages of metamorphic basement rocks.

An Ordovician greywacke exposed in the eastern Qaidam basin (W of Delinghua) yields three 40Ar/39Ar age groups of detrital white mica: 900–922, 610–654 and 527–554 Ma. Furthermore, similar old age groups centering at ca. 670 and 1010 Ma are virtually widespread in recent rivers from Qilian Mountains and clearly demonstrate the presence of Panafrican and Grenvillian tectonic elements in the southern Qilian Mts. at the northeastern edge of the Tibetan plateau. This is consistent with scarce reports of U-Pb zircon and Sm-Nd ages from mainly oceanic tectonic elements. Scarce Panafrican ages were also reported from the North Altyn Mountains, too. These units are bordered by a Lower Proterozoic metamorphic and plutonic basement in the north, mainly exposed in the North Altyn Mts, Beishan and North China craton representing a continental microplate separating these units from the Paleozoic Altaids.

Our preliminary study of detrital white mica from Eocene to Miocene successions of the northeastern Qaidam basin suggested that a basement with 250 ± 3 and 279 ± 3 Ma must be present in the southern Qilian Shan (Rieser et al., 2007). 40Ar/39Ar dating of detrital white mica from outlets of recent rivers draining into the Qaidam yield following age groups: 190–220 Ma, 240–263 Ma, 310–315 Ma, 400–440 Ma and some values at ca. 1010 Ma. The 190–240 Ma group shows a dominant but slightly younger age as found in our previous study from the Qaidam basin fill and indicate that metamorphic basement successions with late Triassic to earliest Jurassic cooling ages are part of the southern Qilian Shan. These new data gives evidence for the presence of Triassic to Jurassic metamorphic sectors in the southern Qilian Shan and that these units are bordered by a Jurassic basin. The lag time between cooling in the hinterland and deposition in Jurassic basin is low implying rapid exhumation in the hinterland.

Based on all these data, we develop a new tectonic model of stepwise accretion of Gondwana-derived units to the northern Lower Proterozoic craton similar as Stampfli and Borel (2002) proposed for the more western Tethysides. Principal age steps of accretion include Late Ordovician-Silurian, Carboniferous and Late Permian-Triassic, the later step also resulting in the final accretion of these units to Eurasia. The Lower Jurassic siliciclastic deposits are thickening towards Qilian Mts. and are interpreted to represent molasse-type deposits to an Indosinian

metamorphic element, which exhumed during early Jurassic times.

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