Commentary on the position of higher Himalayan basement in Proterozoic Gondwanaland

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Until recently the Higher Himalayan Crystalline Sequence (HHCS) was generally regarded to be the basement of the Himalayan Orogen. Our recent field work in the Kali Gandaki area of western Central Nepal showed that the HHCS is likely continuous with the overlying Tethyan Sedimentary Sequence (TSS) stratigraphically and structurally, and therefore does not form the basement of the Himalayan Orogen (Yoshida et al. 2004); a similar view was already mentioned in some earlier works (e.g., Le Fort 1975, Gehrels et al. 2003). Many workers have placed thrust or normal fault, and even unconformity between the HHCS and TSS; but based on our observation it is difficult to confirm any of these relationships. Our observation also conforms to the geochronologic work by DeCelles et al. (2000) that the HHCS is younger than ca 800 Ma and older than ca 480 Ma; this age-range naturally shows the geochronologic identity or continuation of the HHCS with the so far known base of the TSS.

Although the basement of the Himalayan Orogen is not recognized anywhere, its paleoposition can be estimated by identifying the provenance of sediment deposited on the basement. Examination of zircon U-Pb data from HHCS gneisses by DeCelles et al. (2000) showed that the ages of detritus zircons have a range of ca 800~2700 Ma with a main peak at ca 954 Ma; based on these, they suggested the provenance to be the Arabian-Nubian Shield of the East-African Orogen lying to the west of the Proterozoic Himalayan Basin (Indian coordinate within the East Gondwana assembly, e.g., Yoshida et al. 2003). Robinson et al. (2001) showed the Nd model ages of HHCS to lie between 1.36-2.29 Ga (with an exceptional age of 2.85 Ga) and εNd (0) is moderately minus (-7.6~19.9, average–13.8); their neodymium isotopic data indicate the source area to have somewhat long crustal history.

Recent compilation of geochronologic data from the Arabian-Nubian Shield (Johnson and Woldehaimanot 2003) shows zircon ages as well as neodymium model ages from the Arabian-Nubian Shield are a little too younger when compared with those of HHCS, and even bearing many positive εNd values. Although there are some exceptional data showing older neodymium model with highly minus εNd (0) values for rocks from some small areas of older crustal blocks within the Arabian-Nubian Shield, it is difficult to expect considerable amount of material supply from these blocks, since they are thought to lie, if any, below the younger geologic units and only a small amount could have exposed. Gehrels et al. (2003) recently reported somewhat older ages of detritus zircons from HHCS than those reported by DeCelles et al. (2000), showing a major peak range of ca 900-1300 Ma with a main peak of ca 1050 Ma. The wide range of Palaeoproterozoic and late Archaean zircons were also reported, although they form minor populations except those of ca 2500 Ma, which forms the second major peak. Thus, the Arabian-Nubian Shield may not constitute the source for the HHCS.

We propose the Pinjarra Orogen (Western Australia, Fitzsimons 2003) lying to the east of the ancient Himalayan basin in the Proterozoic East Gondwana assembly, to be a more possible candidate for the source area that provided material to HHCS, based on their similar geochronologic and crustal signatures and suitable location near by the Himalayan basin. The Pinjarra Orogen suffered peak metamorphism of ca 1000–1100 Ma with later granitic activity of ca 800-650 Ma and superposed by ca 550–500 Ma Pan-African deformation and metamorphism. Material of rocks in the orogen were derived from Mesoproterozoic Albany-Flaser Orogen of southwestern Australia, in which a variety of older crustal component were incorporated. The ages of rocks from the Pinjarra Orogen are quite conformable with recent zircon data from HHCS (Gehrels et al. 2003). Sporadically known Nd model ages from the Pinjarra Orogen lie between ca 1.6-2.2 Ga, with few exceptions of ca 1.1-1.6 Ga. Thus, it is most likely that the Pinjarra Orogen provided source material for the HHCS. Our conclusion does not support a recent model denoting the Pan-African assembly of East Gondwana (Pisarevsky et al. 2003) in which India and Western Australia do not juxtapose during the Neoproterozoic, but is in favour of the classical model of East Gondwana assembly through the Circum-East Antarctic Orogen of ca 1000 Ma (Yoshida et al. 2003) where Western Australia juxtaposes with northern India.

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