Tibet and Beyond: A Geochemical Perspective on Asian Orogeny and Continental Evolution

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Asia that comprises numerous ancient cratonic blocks and young mobile belts is the largest composite continent on Earth. It was enlarged by assembly of dispersed terranes that, in association with opening and closure of the Paleo-Asian and Tethys oceans, led to significant continental growth. The Central Asian orogenic belt (CAOB), for instance, is celebrated for its accretionary tectonics and production of massive juvenile crust in the Phanerozoic or, predominantly, in the Paleozoic. The Tethyan domain consisted of two major oceans, i.e., Paleo-Tethys in north and Neo-Tethys in south, separated by a strip of continents/terrains called the Cimmerian Continent, most of which had begun splitting from the northern margin of Gondwanaland during Triassic time. Elimination of the Tethys oceans by collisions of the Cimmerian continental fragments and subsequent Gondwana-derived terrains with Eurasia resulted in a double, largely over-printed orogenic system, the Alpine-Himalayan or Tethyan orogenic belt.

Here I present a synthesis of geochemical data of collision zone magmatism from Asia, particularly from Tibet and “CIA” (Caucasus/Iran/Anatolia) in the eastern Tethyan orogenic belt (ETOB) that has traditionally been regarded as a typical collisional system. The dataset suggests that, before the terminal collisions, the entire region was characterized not only by Tethyan subductions but also by accretionary orogenic processes that produced a vast amount of juvenile crust from the Jurassic to Eocene or, in places, to Oligocene. Consequently, both the CAOB and ETOB appear to have evolved through time from an accretionary into a collisional system. The synthesis further indicates that, in contrast to generating massive juvenile crust in the earlier, accretionary stages of orogenic development, crustal recycling plays a more substantial role in the subsequent, collisional stages. The latter involves addition of older continental crust materials into the upper mantle, which in turn melted and caused compositional transformation of the juvenile crust formed in the accretionary stages. Similar features are observed in young volcanic rocks from eastern Taiwan, i.e., the northern Luzon island arc and part of the complex tectonic system in Southeast Asia, where active orogenic processes are operating and thus may evolve one day to resemble the CAOB or ETOB by collision with the northward advancing Australian continent.