

State of geological mapping in the Bhutan Himalaya

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The Geological Survey of Bhutan (GSB), the premier geoscientific organization in Bhutan, is mandated to carry out geologic mapping and exploration projects. Established only in 1981 under technical guidance from the Geological Survey of India (GSI), GSB has endeavored in its capacity to address geoscientific problems and bring geosciences to the forefront in Bhutan despite being a young evolving organization. Geology was virtually unknown in Bhutan until the pioneering work of the Swiss geologist Augusto Gansser between 1958 and 1977, who later published the first geologic map of Bhutan in 1983. This was followed by the publication of another map in 1995 by O.N. Bhargava. This map is the product of many years of mapping expeditions by GSI. These maps were and are the foundations upon which contemporary geologic research in Bhutan is mostly based. GSI left Bhutan in 2002 and since then GSB has been functioning as a fully-fledged geoscientific organization. In an effort to publish its own version of the geologic map of Bhutan, GSB has been systematically mapping the whole country on 50,000 scale even covering areas which remained unmapped due to rugged terrain. So far, GSB has only covered one-sixth of the total area. While trying to understand the geologic setting and tectonic framework of the Bhutan Himalaya, GSB has collaborated with researchers from foreign institutions particularly Princeton and Dalhousie. Besides establishing the regional tectonostratigraphy and mapping some of the complicated structures, introduction of a tectonic model to explain features inherent to the Himalayan orogenesis has taken center stage. The recognition of ductilely deformed rocks led to the inception of the channel-flow model which fundamentally changed our understanding of the role of ductile flow in mountain building processes in collision zones like the Himalaya. A study is underway in western Bhutan to figure out a package of rocks flanked by Greater Himalayan (GH) rocks and consisting of garnetiferous mica schist, quartzite, marble, calc-silicate, and slivers of orthogneiss, locally known as Paro Formation. Establishing the lithostratigraphy of Paro Formation is important because it has been correlated differently by different authors. Whether or not Paro Formation is equivalent to Greater Himalayan, Lesser Himalayan, or Tethyan rocks, has implications for the nature of its contact with the surrounding rocks. The mineral assemblage indicates that Paro rocks in general have attained upper-amphibolite facies metamorphism. This grade of metamorphism is higher than is observed in eastern Bhutan from the same structural level where rocks have attained only greenschist-facies metamorphism.