Mineral chemistry of syn-collisional granitoids and the implications for juvenile crust formation and adakitic magmatism

YUANYUAN XIAO [1, 2]*, SHUO CHEN [1, 2, 3], YAOLING NIU [1, 2, 4]

[1]Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China (*correspondence: yuanyuan.xiao@qdio.ac.cn); [2]Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology, Qingdao 266061, China; [3]University of Chinese Academy of Sciences, Beijing 100049, China; [4]Department of Earth Sciences, Durham University, Durham DH1 3LE, UK;

To testify the hypothesis that continental collision zones are primary sites of net continental crust growth, we focused on trace element geochemistry of the constituent mineral phases for both mafic magmatic enclaves (MMEs) and their host granitoids from two syn-collisional plutons (Qumushan, QMS and Baojishan, BJS) in the North Qilian Orogen on the northern margin of the Tibetan Plateau. The parental magmas of these rocks are thought to be andesitic melts produced by partial melting of the residual ocean crust with some terrigenous sediments under amphibolite facies conditions.

We systematically in-situ analyzed the constituent minerals using LA-ICP-MS and clearly show that different phases preferentially host different trace elements, e.g., most rare earth elements (REEs and Y) in titanite (only found in the QMS pluton), amphibole, apatite, epidote and zircon (mostly heavy-REEs), high field strength elements (HFSEs) in biotite, titanite, amphibole and zircon. Based on the similarities of mineral chemistry and detailed petrological studies, we testify that MMEs are of similar cumulate origin crystallized from primary andesitic melts at the early stage of granitoid magmatism. However, as evidenced by distinct mineral compositions, these two plutons have compositionally different parental magmas, e.g., different Sr/Y and La/Yb ratios in parental magmas. Moreover, primary andesitic magmas with high Sr/Y and La/Yb ratios and fractionation of titanite, zircon and amphibole are both important towards adakitic compositions like the QMS host granitoids. This offers new perspectives on the petrogenesis of adakitic rocks, which deserves further discussions in future. This study also demonstrates that mineral chemistry can offer significant information on the petrogenesis of magmatic rocks.