Magmatism during the closure of the Mongol-Okhotsk Ocean: a tale of a sediment-rich collision

Henriquez, Susana; Lambart, Sarah; Ochir, Gerel; Smart, Sarah; Webb, Laura; Lippert, Peter; Johnson, Cari

Abstract

The Mongol-Okhotsk suture in NE Mongolia and SE Russia is the last vestige of the Mongol-Okhotsk Ocean, a basin that separated the Siberian from the North China Craton. Although the exact location of the suture is cryptic and the timing and kinematics of closure remains debated, magmatism north and south of the suture zone provide insight into the characteristics of the subduction system during the closure of this ocean. Magmatic provinces recording pre-, syn- and post-collisional processes (and potentially deeper mantle sources) along the Mongol Okhotsk Belt were emplaced from the Permian to Jurassic. Our compilation of geochemical, isotopic, and geochronologic data from 51 published studies shows that the age of peak magmatism and subsequent magmatic lull decreases eastward. We interpret this to record a shift in the locus of collision as the ocean zipped close. Most mafic rocks within the suture zone show the influence of lower crustal components and both spinel and garnet peridotites in the source. However, with one exception, their compositions are generally not consistent with a depleted mantle source (usually associated with MgO-TiO2-rich, isotopically fertile, and OIB components). Additionally, although significant geochemical variability due to crustal petrogenetic processes is observed, the data show a ubiquitous subduction signature characterized by enrichment in large ion lithophile elements, light rare earth elements, and La/Nb ratios, as well as by depletion in high field strength elements and heavy rare earth elements. We interpret the consistent peraluminous nature of the magmatic rocks before, during, and after collision, together with their crust-like Nb/U content, high (Th/Yb)/(Ba/La) and (Th/Nb)/(Ba/Nb) ratios, to reflect the strong influence of sediment melts throughout the collision process. This requires not only unusually high geothermal gradients (ca. 200 °C higher than a normal mantle wedge) that can partially melt sedimentary rocks along the whole subduction system, but also persistence of underplated, assimilated, and/or metasomatically incorporated sediments in the magma source during the continental closure. Together, the compiled data paint a picture of a sediment-rich magmatic engine above a hot, dynamic, subduction system with largely intact slabs.

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