

NE Asian arc magmatic tempos and their relationship to Western Pacific-Izanagi plate tectonics since Cretaceous times

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The extensive belts of igneous rocks along the NE Asian margin since Cretaceous times are typically viewed as magmatic arcs produced by subduction of the western Pacific, Izanagi, and other plates. However, NE Asian plate tectonic reconstruction models during these periods are controversial. Furthermore, the NE Asian arc magmatic record has been less systematically cataloged relative to other regions. Therefore, it is still unknown whether any quantifiable relationship truly exists between the NE Asian arcs and plate tectonics. Indeed, arc tempos at other circum-Pacific margins (western North America and South America) show lulls and flare-ups that appear more closely linked to ‘internal’ cyclical processes, including crustal root eclogitization, compared to ‘external’ factors (i.e. plate tectonics).

Here we build a large ($n > 500$) compilation of igneous rock ages and geochemistry along the NE Asian margin along Japan, Sikhote-Alin, and Korea. Our database includes 65 unpublished analyses from northern Sikhote-Alin, Russian Far East, from University of Houston labs. We compare the magmatism against our recently-developed ‘tomographic’ western Pacific-Izanagi plate reconstruction since ~100 Ma, which is a fully-kinematic model that implies spatiotemporal subduction rates along NE Asia.

Our analysis shows that Cretaceous NE Asian magmatism is dominated by higher average silica contents (~69%) relative to other continental arcs. Significantly higher areal addition rates occurred between 56 to 100 Ma (~1100 km²/m.y.) relative to younger <50 Ma periods (~400 km²/m.y.). U-Pb zircon age probability plots revealed a NE Asian arc flare-up at ~85 Ma that had intrusive fluxes reaching 1100 km²/m.y., which are comparable to the noteworthy Sierra Nevada arc flare-up during late Cretaceous times. More vigorous magmatism generally correspond to fast (~15±5 cm/yr) Izanagi-Eurasia plate convergence whereas less vigorous magmatism corresponds to slower (<10 cm/yr) Pacific-Eurasia plate convergence. Magmatic quiescence between 56 to 46 Ma corresponds to Izanagi-Pacific ridge subduction. We discuss the possible role of internal and external processes on NE Asian arc tempos based on our analyses of magmatism relative to plate tectonics.

Keywords: arc magmatism, NE Asia plate tectonics, western Pacific, Izanagi