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Extraction of high-silica granites from an upper crustal magma reservoir: Insights from the Narusongduo magmatic system, Gangdese arc

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Abstract

The genesis of high-silica igneous rocks is important for understanding the behavior of shallow magmatic systems. However, although many such studies have focused on the eruption of crystal-poor high-SiO_2 rhyolites, the origin of high-silica granites (HSGs) has received comparatively little attention. Here, we present a detailed study of HSGs from the Narusongduo volcanic complex, Gangdese arc. Combining zircon U-Pb geochronology with stratigraphic investigations, we show that the Narusongduo magmatic system was constructed over a period of ≥3.7 Myr with or without lulls. On the basis of zircon textures and ages, diverse zircon populations, including antecrysts and autocrysts, are recognized within the HSGs and volcanic rocks. All of the igneous rocks within the Narusongduo volcanic complex have highly radiogenic Sr–Nd isotopic compositions. Our results indicate the presence of an andesitic magma reservoir in the upper crust at a paleodepth of ~8 km. Ubiquitous zircon antecrysts in the HSGs, combined with compositional similarities between the HSGs and evolved melts of the andesitic magma reservoir, indicate that the Narusongduo HSGs represent melts extracted from the shallow magma reservoir. In addition, our results suggest that magma recharge promoted the escape of high-silica melts to form the Narusongduo HSGs. This work presents an excellent case that kilometer-scale high-silica granites are the differentiated products from an upper crustal magma reservoir. It would make a contribution to contemporary debates concerning the efficiency of crystal–melt separation in upper crustal magmatic systems.

Keywords: High-silica granite, magma reservoir, crystal–melt separation, upper crust, rhyolite