Exhumation history and uplift mechanism of the Hida Range based on formation depths/ages of the Pliocene-Quaternary plutons

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Young plutons of 10-0.8 Ma, including the world's youngest Kurobegawa pluton, are exposed in the Kurobe area of the Hida Range, central Japan (Ito et al., 2013, 2017, 2021; Spencer et al., 2019), indicating rapid rock uplift and exhumation in the Quaternary (e.g., Yamada, 1999; Harayama et al., 2003; Oikawa & Wada, 2004). However, reconstructing the exhumation history has been challenging because interpretations of the thermochronologic data are difficult due to the complicated, recent and active thermal history/structure (e.g., Yamada & Harayama, 1999). Here we are determining the exhumation history by estimating formation depths and ages of the young plutons based on Al-in-Hb geobarometry (Hollister et al., 1987; Schmidt, 1992; Takahashi, 1993; Mutch et al., 2016) and zircon U-Pb geochronometry, respectively (Sueoka, 2017). At JpGU2021, we reported the preliminary results based on three datapoints from the ~5 Ma plutons and one datum from the ~0.8 Ma pluton (Sueoka et al., 2021), suggesting the three following interpretations: 1) formation depths of ~5 Ma and ~0.8 Ma plutons were estimated to be ~6-9 km, which indicates an increase of the exhumation rate after ~0.8 Ma, 2) mean exhumation rate since ~0.8 Ma was computed at 8-10 mm/yr in the Baba-dani area, 3) the formation depths are uniform in the E-W direction, disagreeing with the eastward tilting model (Harayama et al., 2003, 2010; Harayama, 2015). As of January 2022, we have obtained 14 datapoints in total: five from the ~5 Ma plutons, two from the ~2-1 Ma plutons, five from the ~0.8 Ma plutons, and two from the >65 Ma plutons. These additional data are basically consistent with the previous data, reinforcing the three interpretations above.

Recently, new uplift models of the Kurobe area were proposed, in addition to the eastward tilting model. Ito et al. (2021) suggested that the Kurobegawa pluton is a resurgent pluton of the Jiigatake caldera and was uplifted by the resurgence. Kawasaki (2021) proposed that displacements related to the E-W compression are localized along the Kurobe area due to the high geothermal gradient caused by presence of thermal fluid interstratified layers. So far, our data are thought to be more consistent with Kawasaki's model. Based on our data, formation depths of plutons in the Kurobe area are spatially homogeneous, which may disagree with the resurgent model in which the Kurobegawa pluton was selectively uplifted. In addition, considering the continuous volcanic activities in the Kurobe area since ~10 Ma (Ito et al., 2013), the drastic change in exhumation rate around ~0.8 Ma is easier to explain by tectonic factors than volcanic factors. For further verification, we are planning to obtain geobarometric and geochronologic data in and around the domain where Kawasaki (2021) suggested the presence of thermal fluid interstratified layers.

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