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Dating of altered mafic intrusions by applying a zircon fission track thermochronometer to baked country rock

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Once a mafic intrusive rock has become altered it is generally difficult to obtain a reliable intrusion age using conventional isotopic methods such as K-Ar dating. Mafic rocks themselves generally contain little or no zircon and therefore are difficult to date by direct zircon U-Pb and fission-track dating. To overcome this problem this study used zircon fission-track (ZFT) thermochronometry to determine the timing of crystallization of altered mafic intrusions [1]. Theoretically, it should be possible to estimate the cooling age of an intrusion by applying the ZFT method to any zircon-bearing country rock located adjacent to the intrusive rock. On this basis ZFT dating was carried out on samples of baked granite country rock adjacent to dolerite dikes (5–10 m thick) in central Japan. Three granite samples collected within 8 mm of a dike contact (Figure 1) yielded consistent ZFT ages of 17–16 Ma, with confined track lengths indicative of the complete annealing of pre-existing tracks by reheating due to dike intrusion. An older ZFT age was obtained for one granite sample collected within 20 mm of the contact, but confined track

length measurements indicate that this is an incompletely reset age that lies between the ZFT age of the unbaked granitic country rocks (c. 55 Ma) and the emplacement age of the dike. Petrographic examinations suggest that post-intrusion hydrothermal activity did not influence the ZFT ages. We conclude that the 17–16 Ma ZFT ages represent the emplacement age of the dikes. Our results show that ZFT dating of baked country rock is an effective tool for dating altered mafic intrusions, for which other dating techniques are not applicable.



Figure 1: Outcrop photograph at the site where a baked contact sample was taken. Note the clear intrusion contact of a dolerite dike that intrudes granite. Small rock fragments were carefully collected by using a slotted screwdriver and a pair of tweezers.

Reference:

[1] Hoshi H et al. (2015) *Island Arc* 24: 221-231

