Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16600

TRACKING GRANITIC MAGMA ORIGIN AND EVOLUTION USING STABLE SILICON ISOTOPES IN ZIRCON

MARTIN GUITREAU[1], ABDELMOUHCINE GANNOUN[1], ZHENGBIN DENG[2], MARC CHAUSSIDON[3], FRÉDÉRIC MOYNIER[4], BERNARD BARBARIN[1] AND JOHANNA MARIN-CARBONNE[5]

[1]Université Clermont Auvergne
[2]Centre for Star and Planet Formation, Globe Institute, University of Copenhagen
[3]Université Paris Cité, Institut de physique du globe de Paris, CNRS
[4]Université de Paris, Institut de physique du globe de Paris, CNRS
[5]Université de Lausanne,

Presenting Author: martin.guitreau@uca.fr

Granite (*sensu lato*), a silica-rich high-temperature magmatic rock, can be produced through various processes and sources resulting in differences in mineralogical, chemical and isotopic compositions [1]. Silicon isotopes in bulk-rocks vary according to granite types [2,3] and these differences may also be detectable at the mineral scale. Zircon a very robust mineral commonly used in Geology, is valuable for tracking magma sources using the Lu-Hf and O isotope systems, as well as dating using U-Pb isotope systems. Combining Si isotopes with traditional zircon methods can offer additional insights into the origin and processes behind granitic magmas, which cannot be obtained from a whole-rock approach, or conventional analyses. This approach may be especially useful for probing the detrital zircon record.

In this contribution, we present recent developments in Si isotope measurements in zircon using LA-MC-ICP-MS in conjunction with complementary solution MC-ICP-MS measurements. The typical internal precision achieved by LA-MC-ICP-MS analyses is 0.12‰ (2SE) and the external reproducibility is 0.20‰ (2SD) on δ^{30}Si. Natural zircon standards have δ^{30}Si signatures that vary between -0.32 ± 0.23 ‰ (2SD) to -0.47 ± 0.17 ‰ (2SD) which is in perfect agreement with theoretical and experimental results [4,5].

Zircon crystals from granitic rocks of various natures, ages and origins were analyzed in order to test whether bulk-rock δ^{30}Si differences were transferred to the zircon scale. Our results show that while zircon δ^{30}Si values may be modified by post-crystallization processes such as alteration, weathering and metamorphism, they are primarily controlled by zircon-melt isotope fractionation. This fractionation is influenced by factors such as zircon crystallization temperature and degree of polymerization (i.e. silica content). Consequently, Si isotopes in zircon provide insight into magma evolution (e.g., temperature and SiO_2 changes) and reveal processes such as magma mingling, fractional crystallization, and/or involvement of multiple sources. This approach offers a useful complement to existing techniques in granite studies involving zircon such as U-Th-Pb, Lu-Hf and O isotopes.

[1] Barbarin (1999) *lithos*; [2] André et al. (2019) *Nat. Geosci.*; [3] Deng et al. (2019) *Nat. Geosci.*; [4] Qin et al. (2016) *Contrib. Mineral. Petrol.*; [5] Trail et al. (2019) *Geochim. Cosmochim. Acta*