

## **Guidelines for reporting Lu-Hf isotope data from zircon**

In order to provide the reviewer and journal readers with sufficient information to fully evaluate the accuracy and reproducibility of Hf isotope data, and the robustness of the conclusions drawn from these data, the reporting of LA-ICP-MS Lu-Hf in zircon isotope data should follow the guidelines below. Note that zircon Hf isotope data need to be paired with accurate U-Pb data to be placed into a temporal context. Guidelines for reporting U-Pb zircon data are provided in a companion document.

### **1. Data table reporting isotope ratios**

The *minimum* isotope ratios to be reported for Hf-in-zircon analyses are shown in the separate template file (Table 1). The  $^{176}\text{Yb}/^{177}\text{Hf}$  ratio should be reported to determine the magnitude of the interference of  $^{176}\text{Yb}$  on  $^{176}\text{Hf}$  (see below). Reporting of a stable isotope ratio, either  $^{178}\text{Hf}/^{177}\text{Hf}$  or  $^{180}\text{Hf}/^{177}\text{Hf}$ , is recommended as an additional monitor of data quality. Isotope ratio uncertainties for individual analyses should be reported at 2 standard errors of the mean.

### **2. Reporting data from appropriate zircon reference materials**

Obtaining accurate  $^{176}\text{Hf}/^{177}\text{Hf}$  ratios from zircon using the LA-ICP-MS method requires correction of the isobaric interferences of  $^{176}\text{Yb}$  and  $^{176}\text{Lu}$  on  $^{176}\text{Hf}$  (Woodhead et al., 2004; Iizuka & Hirata, 2005; Gerdes & Zeh, 2009; Fisher et al., 2011, 2014a; Kemp & Hawkesworth, 2014). Validation of the correction procedures using 'reference' zircons of known and homogeneous  $^{176}\text{Hf}/^{177}\text{Hf}$  (determined by analysis of purified Hf solutions from these zircons) is required. A number of zircons with a range of  $(^{176}\text{Yb}+^{176}\text{Lu})/^{177}\text{Hf}$  values have been characterised for this purpose (e.g., Woodhead et al., 2004; Woodhead and Hergt, 2005; Wu et al., 2006; Blichert-Toft, 2008; Morel et al., 2008; Slama et al., 2008; Fisher et al., 2011, 2014b; Kemp et al., 2017).

Data for reference zircons that cover a similar range of  $(^{176}\text{Yb}+^{176}\text{Lu})/^{177}\text{Hf}$  values as the sample zircons should be reported, ideally analysed in the same session and under the same operating conditions. To demonstrate the veracity of the interference correction procedures adopted by the laboratory over the range of REE/Hf ratios relevant to the sample zircons for which Hf isotope measurements are presented, the accepted (solution) Hf isotope compositions of the zircon reference materials should also be provided. Supporting data from reference zircons should be tabulated in the data table, conforming to the reporting requirements outlined in point (1) above.

### **3. Derivation of initial Hf isotope compositions**

The  $^{176}\text{Lu}$  decay constant and CHUR parameters used to derive initial  $^{176}\text{Hf}/^{177}\text{Hf}$  ratios and  $\epsilon_{\text{Hf}(t)}$  values are to be specified, and the appropriate references cited (see Table 1).

### **4. Reporting of analytical methods**

The minimum following information is required in the analytical methods section for papers that report zircon Lu-Hf isotope data:

- (a) details of the analytical instrumentation and the operating conditions used, including:
  - Faraday cup configuration
  - laser spot diameter, repetition rate and fluence
- (b) procedures employed for data reduction
- (c) details of propagation of analytical uncertainties

## References and further reading

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- Woodhead, J.D., Hergt, J.M. 2005. A preliminary appraisal of seven natural zircon reference materials for in situ Hf isotope determination. *Geostandards and Geoanalytical research* 29, 183-195.
- Wu, F.-Y., Yang, Y.-H., Xie, L.-W., Yang, J.-H. and Xu, P. 2006. Hf isotopic compositions of the standard zircons and baddeleyites used in U-Pb geochronology. *Chemical Geology*, 234, 105-126.

**Table 1.** Exemplar for reporting Lu-Hf isotope data from zircon determined by laser ablation MC-ICPMS.

| Grain.spot | $^{176}\text{Hf}/^{177}\text{Hf}$ | $\pm 2$ s.e. | $^{178}\text{Hf}/^{177}\text{Hf}$ | $\pm 2$ s.e. | $^{176}\text{Yb}/^{177}\text{Hf}$ | $\pm 2$ s.e. | $^{176}\text{Lu}/^{177}\text{Hf}$ | $\pm 2$ s.e. | Total Hf (V) | Age (Ma) | $^{176}\text{Hf}/^{177}\text{Hf}$ (t) <sup>1</sup> | $\epsilon_{\text{Hf}}$ (t) <sup>2</sup> | $\pm 2$ s.e. |
|------------|-----------------------------------|--------------|-----------------------------------|--------------|-----------------------------------|--------------|-----------------------------------|--------------|--------------|----------|--|---|--------------|
| FC1.1      | 0.282188                          | 0.00001      | 1.467228                          | 0.00002      | 0.0335                            | 0.000        | 0.001084                          | 0.00000      | 22.9         | 1099     | 0.282166   | +2.8                                    | 0.6          |
|            |                                   | 8            |                                   | 2            |                                   | 4            |                                   | 2            |              |          |  |   |              |
| OG1.1      | 0.280658                          | 0.00002      | 1.467245                          | 0.00002      | 0.0376                            | 0.002        | 0.001451                          | 0.00008      | 19.5         | 3467     | 0.280561   | +0.8                                    | 0.7          |
|            |                                   | 0            |                                   | 7            |                                   | 1            |                                   | 0            |              |          |  |   |              |

<sup>1</sup> calculated using the  $^{176}\text{Lu}$  decay constant of Soderlund et al. (2004) at the assigned age, t

<sup>2</sup> calculated using the CHUR parameters of Bouvier et al. (2008)