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Supplement of

The rheological behaviour of fracture-filling cherts: example of Barite Valley dikes, Barberton Greenstone Belt, South Africa

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SUPPLEMENTARY MATERIAL

A - GEOCHEMICAL DATA

Geochemical analyses were performed at ISTerre, Grenoble (France) using a Perkin Elmer Optima 3000 DV ICP-AES for the measurement of major element compositions, and an Agilent 7500ce ICP-MS for trace elements. Samples are primarily crushed into powder using agate grinders to prevent contamination, and the procedure is adapted from Chauvel et al. (2011). Accuracy and precision of the data are evaluated using international rock reference materials BHVO₂ and RGM1 as part of the sample set.

- **Major element analyses.** A portion of the powder is precisely weighed (50 mg) and mixed in closed Savillex beakers with 2 mL of nitric acid ($[\text{HNO}_3] = 14\text{mol.L}^{-1}$) and 15 drops of hydrofluoric acid ($[\text{HF}] = 24\text{mol.L}^{-1}$). Samples are entirely dissolved after 7 days onto a hotplate at 90°C. After cooling, 20 mL of boric acid ($[\text{H}_3\text{BO}_3] = 20\text{g.L}^{-1}$) is added to neutralize the excess HF and the solution is further diluted by the addition of 250 mL of Milli-Q water. The complete neutralization of HF by H₃BO₃ is further guaranteed by two days of storage in refrigerators for the solutions, and analyses are performed within the following week. The calibration of the signal is obtained using a blank and mixed solutions containing pure elements: the solutions are prepared using five different dilutions to mimic and calibrate the major element composition of the samples. The volatile content, expressed as the loss on ignition (LOI), is estimated by heating samples at 1000°C for 1h. The concentrations of the analyzed reference materials are generally within 5% of the published values, except for manganese and magnesium oxides in reference material RGM1, and the uncertainties on the measurement (1σ) varies from 0.01% to 1.35%, showing the very good reproducibility of our data.
- **Trace element analyses.** A portion of the powder is precisely weighed (100 mg) and mixed with perchloric acid (HClO₄) and high purity hydrofluoric acid ($[\text{HF}] = 24\text{mol.L}^{-1}$). Samples are cooked in steel Paar bombs during 7 days to allow for the complete dissolution of heavy minerals such as zircons, and the use of HClO₄ is justified by the common presence of organic matter in our samples. The solution is then evaporated using hotplates to obtain a dry residue. The residue is diluted in concentrated HNO₃ for one day before being evaporated again, then diluted in about 40 mL of 7 mol.L⁻¹ HNO₃. A weighed aliquot of this mother solution is sampled and diluted in 2% v/v HNO₃ with HF traces to produce a daughter solution with variable dilution factors according to sample specificities. For the detritus-rich samples and reference materials, best results are obtained for a 2500 dilution. With such values, we minimize the matrix effects while maintaining sufficient signal for all the measured elements. The daughter solution is finally mixed with a spike containing five elements (Be, Ge, In, Tm, Bi) before being analyzed within the day of preparation. The international standard BHVO₂, diluted at 5000, is used for the calibration of the ICP-MS signal and is combined to the reference material RGM1 to estimate the accuracy and precision of our measurement. BHVO₂ composition is within <0.6% of theoretical values, except for As (10.4%), whereas RGM1 more significantly deviates from its theoretical composition. However, uncertainties on the measurement (1σ) of both standards are sufficient to sustain a high reproducibility of the data.

B - ISOTOPIC DATA

In situ isotopic analyses were performed using the CAMECA IMS 1270 ion microprobe at CRPG (Nancy, France), under the direction of Marc Chaussidon and Claire Rollion-Bard. Rock pieces of 1 to 2 cm are placed in aluminum rings and glued with resin before polishing (400, 600, 1200 and 2400 grain/cm² successively, then diamond paste with a granulometry of 3, then 1 μm) and gold coating. Analyses used a primary ion beam of cesium and a beam diameter of 5 μm. The vacuum is stabilized at 10⁻⁸ torr. Two quartz standards serve as reference for oxygen data (Quartz du Brésil = +9.6‰; Quartz NL615 = +18.4‰) and one for silicon (Chert Miocène = -0.69‰).

Accuracy is estimated between $\pm 0.08\%$ and $\pm 0.13\%$ for oxygen and $\pm 0.15\%$ and $\pm 0.24\%$ for silicium.

C - MICROPROBE ANALYSES

The microprobe single-point analyses are realized on the JEOL JXA-8230 equipment at ISTerre, Grenoble (France). Polished and metalized thin sections are scanned using a beam (15 kV) of $<5 \mu\text{m}$ in diameter to prevent multi-phase sampling. The chemical compositions are expressed in weight percent, calculated using internal standard compositions. Silica especially needs to be corrected because, at the time the analyses were made, the spectrometer gave anomalous and systematic + 2 wt% deviations from expected concentrations whereas other elements were unaffected. With the correction, results are precise at $\pm 2\text{-}3 \text{ wt}\%$ in average, generally less than 1 wt%.