Towards a calibration of the "chemical abrasion" technique

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Post crystallisation loss of radiogenic lead from zircon is a major and complex problem for high-precision U-Pb CA-ID-TIMS dating. Radiogenic lead is typically lost from zones within zircon crystals that are metamict as a result of radioactive decay, and directly impacts on the final U-Pb age. Despite the sophistication of the "chemical abrasion" (CA) technique to remove metamict zones of zircon crystals (Mattinson, 2005), there is no guarantee that Pb loss has been completely eliminated. Furthermore, the technique is empirical and is used by different laboratories in slightly modified versions in terms of duration and temperature of the annealing and the partial dissolution steps.

Without a detailed understanding of how the temperature and duration of the partial dissolution step affects metamict and non-metamict zones in zircon, U-Pb data from different laboratories applying different conditions are problematic to compare quantitatively. As a consequence, it may be problematic to reject U-Pb dates of single zircon grains because they are younger than expected, and it may be difficult to justify that the young age is the result of residual loss of radiogenic lead. Therefore, to arrive at a reliable age interpretation of a group of zircon dates will require the control on factors that cause the dispersion of ages.

We combined Raman spectroscopy, EMPA, CL imaging, LA-ICP-MS trace element analysis and CA-ID-TIMS dating on the reference zircon Plešovice (Sláma et al., 2008), in order to determine and quantify the effect of variable conditions during the partial dissolution step of the chemical abrasion procedure on the zircon chemistry, crystal stucture and the final U-Pb date. With this approach we intend to quantify the criteria for the pre-selection of zircon grains for the chemical abrasion and to tailor the conditions of the partial dissolution step based on the zircon chemistry and its structural state.