DO WE REALLY NEED TENS OF KILOGRAMS OF ROCK SAMPLES TO CONCENTRATE ZIRCON FROM MAFIC MAGMAS?

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Geochronology is a remarkable tool that allows for a direct assessment of geological problems or positioning of events on chronostratigraphic scales. Zircon U-Pb geochronology is the most successful method available, since zircon can survive a range of different alterations, the U-Pb method has in situ and isotope dilution techniques, and the dual decay of $^{238}U–^{206}Pb$ and $^{235}U–^{207}Pb$ provides an internal cross-check of closed system behavior of the mineral. Nevertheless, zircon dating is not always appropriate in mafic rock studies because of the magma emplacement temperatures and SiO_2 saturation conditions that are often outside of the zircon crystallization window. Even so, it is the difficulty in concentrating zircon from mafic rocks that hinders our capability to apply this geochronometer to these tectonomagmatic events. Usually, large rock volumes are sampled in order to compensate this issue, meaning that if one can concentrate just a few crystals per kilogram, by sampling large quantities of rock enough crystals may be separated. However, do we really need large amounts of mafic rock samples to concentrate enough zircon crystals for a dating experiment? A continuous process of conceiving new techniques for concentration and separation of these minerals on a range of different rock compositions has been pursued. Here, we show that a separation technique that substitute physical process by a chemical dissolution makes it capable to concentrate viable amounts of zircon crystals from mafic rocks using, on average, only 1kg (or less) of rock sample. This is grounded on the idea that what hampers the capability of zircon concentration on mafic rocks is the relation between these crystals and magnetic phases that are particularly abundant on such rock types, and which are lost during magnetic treatments such as hand magnet and Frantz processing. Furthermore, crystal sizes are exceptionally important because, on sub-abyssal to extrusive environments, zircon may form crystals of less than 50 µm, which may be lost during density liquids treatment. Thus, by substituting the conventional physical separations for a bulk rock chemical digestion, the recovery rate in relation to the conventional zircon separation techniques is approximately one hundred times better. In the chemical dissolution technique, the sample is initially grounded to sand-size particles and the heavy minerals are concentrated via water table separation, this is the only physical treatment employed. Then, the heavy minerals portion is heated at 900 ºC for 60h on a muffle furnace and put through four steps of acid digestions: aqua-regia, hydrofluoric acid, aqua-regia and finally hydrochloric acid. This method allows the separation of a roughly pure zircon concentrate, since the method design was established so zircon is one of just a few mineral phases that can survive these acid attacks. In all, zircon concentrated from the chemical separation method allows for a cut of sample masses from tens of kilograms to only one kilogram or less, which is especially relevant to mafic rock studies but can also be expanded to other "difficult to concentrate zircon" rock types.

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