A Sequential Leaching Method to Measuring Primary Signatures on Partially Altered Bulk Carbonates

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The application of stable isotope systems to geological problems has led to an immense leap in our understanding of earth history. Analytical techniques and our understanding of these systems are rapidly improving however as we move deeper in time and seek to improve our sample resolution we reach a limit due to sample preservation. Carbonates are by far the most utilized rock type for geochemical measurements due to their preservation of marine geochemistry, however they are sensitive to overprint during diagenesis and burial. Multiple techniques have been developed to differentiate between altered and well preserved samples yet as we attempt to push geochemical records deeper in time we will increasingly need to use partially altered samples for analysis.

We have developed a sequential leaching method where samples are leached by progressively stronger acids and each leachate is analysed separately. Combined with major and trace element data for each leaching step, we can separate out primary signatures from secondary overprint. We have collected a set of carbonate samples through a number of well dated Phanerozoic carbonate sections which span from primary limestones progressively towards dolomite. Combined with major and trace element analysis, we can separate out primary signatures and produce Sr isotopes from primary leaches identical to the globally recognized curve for partially altered sample.

While measuring highly altered samples will remain difficult, this method greatly increases our range of possible samples for inorganic geochemical analysis. This will be of most use in the early Proterozoic and Archean where well preserved and well dated samples are difficult to identify and access.