Comparison of the stable isotopes in the juices of fast-growing vegetables and slow-growing fruits

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In recent decades, ^{18}O and ^{2}H or D have also been used in forensic studies to prove product authenticity. This application has been particularly useful in food quality control because it allows for the detection of added sugar and water in fruit juices or milk and in tracing the geographical origin of food products. The isotopic enrichment, which was ascribed to evaporation, has since been used to monitor for the addition of water to juice concentrates. However, the available isotopic data on fruit and vegetable juices are currently very limited. In particular, no study has compared the intensity of evaporation between fast-growing vegetables and slow-growing fruits, which grow under the same climatic conditions. In addition, no evaporation study has been conducted using source water to estimate the amount of isotopic enrichment in fruits and vegetables.

We have analyzed the oxygen and hydrogen isotopic composition of juices from fruits and vegetables collected from a small orchard in order to investigate the differences in isotopic enrichment and evaporation intensity between fast-growing vegetables and slow-growing fruits grown under the same climatic conditions. The oxygen and hydrogen isotope levels were much higher in the juices of the fruits and vegetables than in the source waters in which they grew because of evaporation effects. According to our data, fast-growing vegetables are subject to greater evaporation than slow-growing fruits. An evaporation experiment using the source water showed that the oxygen and hydrogen isotopic composition of the 60~80% residual fraction was similar to that of the isotopically enriched grape juice, whereas those of the plume and tomato juices were very close to that of the 80~90% residual fraction, thus proving the effect of evaporation.

Redox state of the Neoproterozoic oceans: Insights from the REE and Cr isotopes

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The Neoproterozoic (700-545 Ma) is one of the most important periods in the chemical evolution of the Earth. It is characterized by two or three global glaciations as well as major changes in atmospheric oxygen. During the last of these glaciations (the Gaskiers), the composition of atmospheric O_2 is thought to have increased from 6% to 20% [1]. This would cause major changes in the redox state of the oceans. Although many models have been proposed to explain the glaciations [2], there have been few studies of the evolution of the redox state of the Neoproterozoic oceans.

In order to improve this situation, we have measured concentrations of the redox sensitive elements (including Ce, Eu, and Fe) in Neoptorterozoic carbonates from the Sturtian (720-700 Ma) and Marinoan (650-630 Ma) glaciations. Concentrations of the REE vary by a factor of ten, but shale normalised REE patterns for carbonates from both glaciations have no significant Ce or Eu anomalies (Ce/Ce* = 0.9-1.07 and Eu/Eu* of 0.95-1.15). The Ce data strongly suggest that the redox state of shallow continental seas was reducing 630 million years ago.

Cr isotopes are significantly fractionated during the reduction of Cr(VI) to Cr(III) (by up to 7‰ [3]) and we have measured small (~0.2‰) shifts in Phanerozoic sediments that record oceanic anoxia [4]. Chromium has an advantage over many other redox indictors in that it has a relatively simple speciation chemistry and our data suggest that Cr isotopes are very sensitive to small redox changes. Neoproterozoic carbonates contain 1-7 ppm Cr and we will present preliminary Cr isotopic data for the two glacial sequences.

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