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Triple oxygen geochemistry of hydrothermally altered rocks constrains atmospheric conditions during climate transitions.

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Oxygen and hydrogen isotope data of plutonic and sub-volcanic igneous rocks from fossil hydrothermal systems have been proven useful to interpret the stable isotope composition of past meteoric waters which interacted with the rocks at the time of hydrothermal circulation (e.g. Taylor and Forester, 1979; Criss et al., 1982; Nevle et al., 1994). Triple oxygen investigation has allowed a step forward in the calculation of past isotopic values of natural (meteoric and/or sea) waters, providing useful insights to understand the possible mechanisms influencing atmospheric dynamics during past climatic conditions (e.g. Herwartz et al., 2015; Zakharov and Bindeman, 2019; Dallai and Sharp, 2024). Particularly, the Eocene-Oligocene transition is characterized by a dramatic change in the isotopic composition of meteoric waters. During the transition from an ice-free planet to the glaciated world, the stable isotope composition of meteoric precipitations were set to more negative O-, and H-isotope values, resulting from a progressive atmospheric cooling, reduction in relative humidity, and change in moisture source regions. New data on a series of hydrothermal systems from northern Victoria Land, Antarctica, compiled with data on granites from the British Tertiary Province, Greenland, and North America are reported. These data cover continuously a time span from 55 to 25 Ma. By using the triple oxygen isotope geochemistry, combined with well-established water-rock interaction models, a quantitative paleoclimatic proxy of a changing climate has been retrieved. The isotopic variations can be linked to the combined effect of atmospheric CO_2 reduction, and to the rearrangement of oceanic currents. Data from high latitude regions of both hemispheres will help to determine continental paleo-temperatures of the climatic transitions during the Cenozoic and to define bi-polar climatic conditions through geological time.

References

Criss, R.E. et al., 1982. JGR 87, 7026–7046.
Dallai L. and Sharp, Z.D., 2024. Nature Comm. 15:4509.
Herwartz D., et al., 2015. PNAS, 112, 5337–5341.
Nevle, R.J. et al., 1994. Geology, 22, 775–778.
Taylor, H.P., and Forester, R.W., 1979. J. Pet. 20, 355-419.
Zakharov D.O. and Bindeman I.N., 2019. GCA, 248, 185–209.