Time-space evolution of the Abitibi-Wawa: New insights from Hf-O isotopes in zircon

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The Neoarchean represents a major planetary thermal event characterised by the widespread eruption of major basaltic sequences analogous to large igneous provinces (LIPs), komatiite volcanism, and significant crustal development, culminating in the cratonisation of the early continents. However, despite the scale and influence of this event on the history of our planet, the driving mechanisms behind it remain unclear.

This study looks to investigate this problem via the spatial application of isotopic data. The use of Lu-Hf and O-isotopes in zircon, in combination with U-Pb geochronology, has become a vital tool in our quest to understand crust-mantle evolution. However, these data are almost exclusively used in a temporal context, and any spatial variation within cratons is often overlooked. As a result, we present isotopic maps from a new Hf-O dataset of 165 samples (3300 analyses) from across the Abitibi-Wawa (Superior Craton), to constrain the time-space evolution of this area, and shed light on geodynamics in the Neoarchean.

Initial isotopic results demonstrate a clear spatial variation in εHf. The area as a whole has εHf<0, but subtle variations within these data correspond to east-west trending zones of relatively more- or less-juvenile crust. Heat-flow appears to be focused in the more juvenile regions, supported by the occurrence of base-metal and gold deposits in these areas. The edges of these zones correlate with major regional structures, such as the Porcupine-Destor Fault. The $\delta^{18}O$ data predominantly fall in the mantle field, but a small component of data range to ~7.0 and ~3.0‰, suggesting the involvement of sedimentary or metamorphic material, and hydrothermal processes, respectively. The occurrence of 2.9-2.8 Ga zircons suggests a Mesoarchean basement, contrary to models for an 'oceanic' origin.

As a result, these new data point to a setting analogous to a continental rift zone for the formation of the Abitibi-Wawa Terrane, perhaps similar to the Basin and Range province, and we suggest such a setting was a vital apart of Neoarchean crustal growth and crust formation.

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