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A comparison of oxygen fugacities of S-type granites across the Archean-Proterozoic boundary

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The partial pressure of oxygen in the atmosphere, and therefore mechanisms of weathering/alteration and redox conditions during sediment deposition and diagenesis varied over Earth's history. It might therefore be expected that this would be expressed as secular variations in the fO_2s of igneous rocks that contain sediments as source components or contaminants. The largest recognized increase in the partial pressure of atmospheric oxygen occurred circa 2.4 Ga during what is known as the "Great Oxygenation Event" (GOE). The GOE left clear imprints of increased pO_2 on the sedimentary rock record, including the appearance of fluvial and nearshore red beds and retention of iron in paleosols, the disappearance of readily oxidized detrital minerals such as pyrite and uraninite from clastic sedimentary rocks, and the appearance of evaporative sulfate mineral deposits. Since they are generated by melting involving such sediments, S-type granites derived from sedimentary rocks deposited on either side of the GOE might have significantly different fO_2s, mirroring such an abrupt change in the redox state of Fe and S their sedimentary sources. However, it is also possible, despite variations in atmospheric pO_2, the bulk redox state of sedimentary source material depends strongly on the details of its depositional environment and the presence or absence of organic carbon. In this talk, I will develop constraints on the fO_2s during crystallization of Archean and Proterozoic S-type granites to determine whether changes in atmospheric pO_2 levels across the GOE are recorded in granites from the continental crust. To isolate the effects of sediment melting or incorporation into igneous rocks and to provide the most direct link between igneous rocks and changing surface conditions, I studied a geographically distributed suite of North American Archean and Proterozoic S-type granites. To place constraints on the fO_2s of the S-type granites, I compare Fe^T/Fe^T+Mg ratios in biotite and their host rocks, which when examined together and compared among similar rock types, are highly sensitive to the fO_2 during crystallization. I will discuss our results in light of changes in the sedimentary redox budgets for C, Fe, and S across the GOE.