Is Paleoproterozoic atmospheric oxygenation linked to the emergence of continents above sea-level? Evidence from sulfur and oxygen isotopic signatures in Archean to Proterozoic sediment-derived granitoids.

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The oxygenation of the Earth's atmosphere at ~2.35 Ga termed the Great Oxygenation Event (GOE) irreversibly changed major biogeochemical cycles on Earth and provided the base for highly efficient aerobic metabolism that allowed development of complex life. It remains a matter of debate whether a decrease in O_2 consumption or an increase in O_2 production led to the build-up of free oxygen. The drastic impacts of the GOE on the Earth's surface environment are imprinted on the geologic record, such as the observation of predominantly mass-independent fractionation of sulfur isotopes (S-MIF) pre-GOE to predominantly mass-dependent fractionation post-GOE. Recent studies show that fluctuations in atmospheric O_2 level are also captured in the igneous rock record and the deeper crust, *e.g.*, through a change in average oxygen fugacity of strongly peraluminous granites and recycled S-MIF in igneous rocks. Coevally with the rise of atmospheric O_2, the triple oxygen isotope composition of shales (expressed as $\Delta^{17}O$) and the $^{18}O/^{16}O$ composition of felsic magmas are subject to a rapid change at 2.35 Ga, which has been linked to the widespread emergence of continents above sea-level at that time. In this study we present triple sulfur isotopic signatures of pyrite and oxygen isotopic signatures of garnet and zircon in a global sample set of Archean and Proterozoic sediment-derived granitoids. These sediment-derived melts record an increase in average garnet and zircon $\delta^{18}O$ and a disappearance of pyrite S-MIF in the Paleoproterozoic. The coupled behaviour of sulfur and oxygen isotopic signatures in these samples imply that there may be a causal link between the emergence of continents and the rise of free oxygen at ~2.35 Ga, perhaps linked to the way subaerial continents remove carbon dioxide from the atmosphere and increase the supply of nutrients for oxygenic phototrophs in the ocean.