Measurements of oxygen flanking the GOE

N.BLAMEY[1,2,3], U.BRAND[4],C.LECUYER[5], J.PARNELL[2], M.HEIZLER[3], A. LEPLAND[6], N.BEUKES[7], B.SMITH[7]

[1]Dept. Earth Sciences, Western University, London, ON, CANADA. nblamey2@uwo.ca
[2]Dept. Geol & Petrol. Geol., University of Aberdeen, UK
[3]Dept. E&ES, New Mexico Tech, Socorro, NM, USA.
[4]Dept. Earth Sci., Brock Univ., St Catharines, ON, CANADA
[5]University of Lyon, Villeurbanne, FRANCE
[6]Geological Survey of Norway, Trondheim, NORWAY
[7]Dept. Geology, Univ. Johannesburg, Johannesburg, RSA.

The rise of atmospheric oxygen during the Proterozoic is of great interest, especially flanking the GOE. Isotopes and RSEs have been the mainstay of geochemical tools to estimate oxygen changes during the Proteorozic whereas we present quantitative fluid inclusion gas analyses from geological materials that formed either in the shallow marine environment or at the atmosphere-brine interface.

Gas analysis of halite inclusions is a proven methodology (Blamey et al., 2016) and measures the atmospheric oxygen level by mass spectrometry. The volatile species measured include: H_2, He, CH_4, H_2O, N_2, O_2, H_2S, Ar and CO_2. Here, the gases are normalised to the sum of N_2, O_2 and Ar. Halite was screened using the Blamey and Brand (2019) protocol.

Halite-hosted fluid inclusions from the 2.0 Ga Tulomozero Fmn in Russian Karelia were analysed giving O_2 measurements that range from 14.2-18.4 %, or 68-88% PAL.

Calcite ooids from the 2.3 Ga Boomplaas Fmn of South Africa were analysed and the oxygen from the ooid-hosted inclusions range from 1.7 to 2.6%. Whereas halite grows at the brine-atmosphere interface, ooids form in the shallow marine environmnt and therefore we use Henry's Law constants to calculate the atmospheric oxygen levels. This provides the first direct oxygen measurements prior to the GOE of 4.5 to 6.9% PAL.

Our team has proven that atmospheric O_2 was 50-60% PAL during the Tonian, 8-10% PAL at 1443 Ma, 68-88% PAL at 2.0 Ga, and now 4.5 to 6.9% PAL at 2.3 Ga.

Blamey & Brand, 2019, Gondwana Research, v. 69, p. 163-176.

Blamey et al., 2016, GEOLOGY, v. 44, p. 651-654.