Sulfur isotopic compositions of sulfides from the Huronian Supergroup, Canada

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Mass-independent isotopic fractionation (MIF) of sulfur found in sedimentary rocks older than 2470 Ma implies that the atmospheric oxygen level was lower than 10-5 PAL (present atmospheric level) in the Archean atmosphere if the MIF was caused by photochemical reactions of volcanic SO2 [e.g., Farquhar J. et al., 2000; Pavlov and Kasting, 2002]. Sulfides from the Rooihoogte and Timeball Hill Formations, Transvaal Supergroup, South Africa, (2316 +/- 7 Ma; Hannah J. L. et al., 2004) show only a small degree of MIF [Bekker A. et al., 2004a], suggesting that the atmospheric oxygen level reached 0.00001 PAL by 2316 Ma. The Huronian Supergroup in E. Canada recording three Paleoproterozoic glaciatial events between ~2450 and ~2220 Ma is correlated with the Rooihootge and Timeball Hill Formations, and may record the evidence of the great oxygenation event. The sulfur isotopic compositions of sulfides in the Matinenda to Gordon Lake Formations of the Lower Huronian Supergroup exhibit D33S, deviation from a mass-dependent fractionation line, of less than 0.5 permil [e.g., Farquhar J. et al., 2000]. Although recent measurements have shown that sulfides in the Mississagi Formation may have D33S of +/- 1 permil [Bekker A. et al., 2004b], the degree of MIF is smaller than those seen in Archean sulfides. This suggests that the atmospheric oxygen reached a level that is high enough to vanish the large MIF signature before the deposition of the Matinenda Formation. In this study we report sulfur isotopic compositions of sulfides from the Huronian Supergoup, especially sulfides from the Livingstone Creek, Thessalon, and Matinenda Formations of the Lower Huronian Supergroup in the Elliot Lake area. The Livingstone Creek and Thessalon Formations underlie the uraniferous Matinenda Formation. In-situ ion microprobe (Cameca ims-1270 at GSJ, AIST) measurements showed that most of sulfides have a small degree of sulfur MIF, as seen in other formations, except for sulfide blocks in the polymictic conglomerate of the Livingstone Creek Formation, the lowermost Huronian Supergroup. The sulfides in the Livingstone sulfide blocks show a clear evidence of MIF (D33S = -1.7~+3.6 permil) with d34S of -4~+2 permil. The range of MIF from the sulfide blocks is an order of magnitude larger than that for other sulfides from the Huronian Supergroup. Although it is unknown exactly when those sulfides formed at present, our observation indicates that the atmospheric oxygen may have started to increase after the formation of the sulfide blocks and before the deposition of the Livingstone Creek Formation.