

Mistassini-Otish Impact Structure IV: Significance of the shock metamorphism observed over 450 km in detrital sediments deposited prior to 2.17 Ga in the structural troughs developed within the Grenville foreland zone.

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Impact formations have been found in the Mistassini basin, bridging the Chibougamau Formation and the Otish Group for which shock metamorphism features had been previously observed. These impactites are preserved within structural troughs pertaining to a multi-ring impact basin: the Mistassini-Otish impact structure (MOIS). The event is tentatively dated at 2.17 Ga, i.e. the age of the Otish gabbro which is interpreted as a «mare basalt» which ground-hugged and capped the ejected materials. The transient crater diameter has been estimated to be 508 km and the final crater in the order of 1150 km, thus being the largest impact structure ever reported for the Earth.

The shock stages and pressures determined are respectively F-S5 and >35 GPa for the Chibougamau mining camp, F-S6 and >60 GPa for the Mistassini basin, and SR-S4 or SE-S4 and >5.5 GPa for the Otish basin. It is important to note that carbonates are not considered in this classification. Nevertheless, the huge carbonate melt sheet that filled the Mistassini trough is obviously the most striking feature.

The targeted terrain was likely a thick carbonate platform in development on a continental margin where stromatolites were flourishing. The timing of the MOIS event nearly coincides with some major changes in atmosphere and Earth's interior such as the Great Oxygenation Event *ca.* 2.3-2.1 Ga, the seemingly coeval Lomagundi Carbon Isotope Excursion, the huge magmatic event observed *ca.* 2.2 Ga in the Canadian shield which involved mixing of crustal and mantle rock units, the ore genesis of the Chibougamau mining camp inferred to a major regional event *ca.* 2.2 Ga amongst others. The most interesting input is probably the availability of reduced phosphorus to living organisms through the arrival of airborne glassy P-rich spherules. Given the energy developed by the event, the Mistassini spherule layer was deposited worldwide, thus providing reduced phosphorus everywhere on the Earth's surface.

Finally, the thickness of the impact magma developed by the MOIS event could have reached >23 km according to impact modeling, an information that should be taken into account when dealing with the emplacement of anorthosite massifs that occur in the Lac Saint-Jean area.