# PRELIMINARY CHARACTERIZATION OF A PHOSPHORUS-RICH SPHERULE LAYER DISCOVERED WITHIN THE MISTASSINI GROUP, NORTHERN QUEBEC, CANADA

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**Introduction:** Two spherule layers 40 km easterly apart have been discovered while performing a regional survey around the Lake Mistassini last year [1]. Both layers are contained within the basal dolomite units of the Albanel Formation [2] [3]. The age of emplacement is likely between 2515 and 2169 Ga [1] [4] [5]. Hereafter, are presented the very preliminary results of our currently ongoing study concerning the westernmost layer found on an island of Lake Mistassini (N51°08'50" / W73°31'13").

**Stratigraphic control:** The dolomite within which the spherule layer is settled overlies a complex unit that has been previously described as a conglomerate with a dolomitic matrix [6]. The size of the fragments ranges between 1 cm and 6 m. Later on, that unit has been reinterpreted as a regolith [7]. According to our current research, some of the fragments, if not all, enclose limpid anhedral quartz crystals that have sequestered micro-spherules made of exotic materials. The weathering conducting to a regolith does not suffice to explain that observation. So, the regolith interpretation is certainly questionable and must be further reconsidered as an impact product.

**The layer:** The layer is made of closely packed millimeter-sized spherules embedded within a dolomitic matrix. Its aggregated thickness is difficult to establish because the layer has been dismembered and the time spent on the outcrop was too short to adequately quantify it. So, the thickness is presently roughly estimated to be one meter. Interestingly, a 3 meter thick sandstone unit offering the same texture as that of the spherule layer has been reported some 100 km to the south [7]. The sandstone could have been mistakenly reported as such.

**The spherules:** The shape of the spherules encompasses the full range of the splash forms characterizing the mictotektites (microkrystites) [1]. Some spherules have been elongated, slightly deformed and stretched after their fall. Most of the spherules display a fairly well developed fibrous reaction crown. These crowns vary from 50 to 100 microns in thickness, are quite rich in crypto-inclusions and have nearly been all replaced by larger dolomite crystals from the matrix. A rare pair of spherules has frozen in the act of splitting from one another leaving a very thin connection in between the spherules. Main spherule components observed are a calcium phosphate glass (SEM measurements given in atom. %, Ca 21,41; O 50,23; P 9,42; C 7,15; B 5,5; F 2,89; Si 1,12 and traces of Al, Mg and Na), quartz, apatite, calcite and opaque minerals. Immiscibility features with the Ca-phosphate glass are visible in the case of multi-component spherules. Also accompanying the spherules are sub-angular to sub-rounded fragments, sometimes very elongated, some of which are made up of micro-spherules composed of cryptocrystalline opaque minerals, other fragments made of cryptocrystalline carbonates, and some broken fragments of larger spherules. A number of spherules have a partial to full outer shell wall made of micro- to crypto-crystalline minerals, the thickness of the shell is usually a few microns up to 10 microns thick.

**The matrix:** The matrix holding the spherules is composed of fine-grained anhedral dolomite grains which have about 5% to 15% dark inclusions from less than 1 up to 3 microns in diameter giving the crystals a dirty appearance compared to the clean look of the calcite crystals inside some of the spherules. Up to now, microscopic and field observations do not concur with the usual features displayed by carbonate sedimentation. So, the dolomite-rich matrix of the spherules is presently interpreted as a carbonate melt.

**Conclusion:** The present spherule layer is tentatively correlated with the Greenland distal layer [1] for which the source remains unknown [8]. Nevertheless, given the composition and shape variance of the spherules, its architecture, its internal soft deformations, and its stratigraphic relationship with the underlying 'regolith' which display the same dolomite matrix support, the Mistassini spherule layer is instead considered proximal. Although the spherules of South Greenland display a lower density, a better roundness, a smaller medium size and a higher glass content (based on thin sections kindly provided by Dr Bruce Simonson), given the distance in between both layers, the correlation may stand. Among the preliminary results obtained until now, the high phosphorus content of the spherules is certainly the most interesting. Whatever its origin, i.e. an impactor possibly enriched in schreibersite or some targeted Fe-Ti-V-P ore body associated with massif-type anorthosites, given the timeframe established for the catastrophic event, that finding obviously deserves a real attention when dealing with the evolution of life on Earth.

**References:** [1] Genest S. and Robert F. (2007) *In 80th Annual Meeting of the Meteoritical Society*, Santa Fe, New-Mexico (Abstract). [2] Chown E. H. and Caty J. L. (1973) *The Geological Association of Canada*, Special Paper 12:49–71. [3] Caty J. L. (1976) *Ministère des Richesses Naturelles du Québec*, DPV-423: 270p. [4] Hamilton M. A. (2009) *Ministère des Ressources Naturelles du Québec*, MB 2009-17. [5] Hamilton M. A. and Buchan K. L. (2016) *Canadian Journal of Earth Sciences*, 53: 119-128. [6] Gros J. J. (1972) *Ministère des Richesses Naturelles du Québec*, DP-31 : 10p. [7] Gros J. J. (1975) *Ministère des Richesses Naturelles du Québec*, RP-610 : 29p. [8] Chadwick B. et al. (2001) *Journal of the Geological Society, London*, 158: 331-340.