
**Laser-ablation ICP-MS analysis of freshwater
ferromanganese nodules**

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Freshwater ferromanganese nodules are common in New Brunswick lakes. Their growth is gradual over 100s to 1000s of years by precipitation of Fe and Mn oxides around a pebble nucleus. With a concentric growth pattern, they have the potential to contain time-series records of aquatic-chemical and climate data for the region in which they are found. In order to extract this time series data an understanding of the chemical composition of the nodules is essential. Laser-ablation ICP-MS provides a way to obtain high spatial resolution analytical profiles across

the nodules for a large range of elements, but the method requires development of LA-ICP-MS standards. Thirteen ferromanganese nodule samples with a range of Fe:Mn ratios, and two USGS marine manganese nodule standard reference materials, were selected for the preparation of LA-ICP-MS standards. Approximately 100 mg of powdered nodule material were added to 25 mL of a 0.5 M solution of oxalic acid. This mixture was placed in a water bath at 80°C for 24 hours until all Fe and Mn oxide powder was dissolved. The solution was then filtered (0.45 µm) to remove undissolved silicate particles and the filtrate was taken to a final mass of 50 g with 2% HNO₃. Samples were analyzed by ICP-MS for As, Ba, Ca, Co, Cu, Ni, Pb, P, Sb, Sr, Th, U, V, Zn, as well as Fe and Mn. Having determined the major and trace-element concentrations, pressed pellets were prepared for LA-ICP-MS standards from subsamples of each powder material. Once the approach to laser ablation analysis has been optimized, work will proceed to analyze nodule thin sections, concentrating on line profiles along the nodule growth directions.