
**Geological provenance of the Titanic gravestones in
Halifax, Nova Scotia: a 100th anniversary forensic igneous
petrology progress report**

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The range of physical (e.g., colour, density, mineral assemblage, modal proportions, and texture), chemical (majors, traces, isotopic ratios of bulk rock and individual mineral phases), and temporal (radiometric age) properties of geological materials is large, but for single samples these combined properties can form a unique set that is the equivalent of DNA in biological material. Thus, ideally, any geological sample should precisely match its original outcrop; more practically, a geological sample should at least match the collective characteristics that define its formation, facies, or unit of origin.

In Halifax, Nova Scotia, 150 victims of the sinking of the Titanic in 1912 lie beneath petrologically identical headstones. That dimension stone, presumably supplied by the White Star Line, arrived in the port of Halifax about seven months after the Titanic sank, but no record in any newspaper, surviving shipping documents, or quarryman's journal indicates the source of this particular stone. In layman's terms, it is a "black granite"; in IUGS terms, it is a medium- to coarse-grained olivine gabbro with

cumulus phases consisting of euhedral plagioclase (An₅₀₋₇₀), corroded olivine (Fo₆₃), minor orthopyroxene (En₆₀), and titanomagnetite (7.5 wt.% TiO₂) with Ti-hornblende and biotite reaction rims, and intercumulus material consisting of titanite (Wo₄₃En₄₂Fs₁₅) with reaction rims of titaniferous hornblende, both of which appear to be uralitized. This noritic gabbro is distinctive for its orthopyroxene, reaction rims on titanite and titanomagnetite, alteration to uralite, high K₂O content (in the biotite and Ti-hornblende), and high water content (biotite, hornblende, and uralite). A ⁴⁰Ar/³⁹Ar determination on biotite yields a radiometric age of approximately 450 Ma. A new U-Pb determination on zircon should yield a more precise age.

There is no known source for this rock in eastern North America. Physically, chemically, and perhaps even temporally, the Halifax gravestones are consistent with the Younger Gabbros of northeastern Scotland; however, so far no extant quarry matches them, no known cemetery headstones match them, and no current stone cutter in Aberdeenshire recognizes them. Alternatively, the White Star Line, which built the Titanic in Belfast, may have obtained the dimension stone from an appinite quarry somewhere in Northern Ireland (Newry) or Eire (Mayo, Leinster, Donegal). Similar rocks also occur in Scotland (Appin, Loch Lomond), but with an age of ca. 430 Ma, are too young to be a suitable match, unless the new zircon date is younger than the argon date. The search for the source continues.