Metamorphic mineral assemblages in fossils in the contact metamorphic rocks of the Portrush Sill, Northern Ireland

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One of the first examples of the occurrence of fossils in a metamorphic rock was originally described as *"shells in basalts"* in samples from Ramore Head in Portrush, Northern Ireland as early as 1799. The Ramore Head site has a special significance in the history of geology as it played a large role in settling the dispute between the Neptunists and Plutonists over the origin of basalt. An 1806 description of the fossiliferous "basalts" at Portrush by a noted Neptunist notes: *"A variety of basalt, found in abundance at Portrush, and the Skerrie Islands, is full of pectinites of belemnites, and, above all, of cornua ammonis: these are dispersed through the whole mass, equally abundant in the interior, and on the surface. This basalt vitrifies, and the marine substances, it contains, calcine, in the fire of a common salt-pan; of course, never could have sustained a volcanic heat".* The plutonist camp responded with the conclusion: *"that the stones which contained the shells, or the impressions of the shells, were no part of the real basalts. They were all very compact, and had all more or less of a siliceous appearance, such as that of chert; they had nothing of a sparry or crystallized structure…"*

Despite their historical importance and a growing interest in fossil preservation in metamorphic rocks, the mineralogy and texture of the metafossils has never been described. The metafossils occur in hornfelsed Jurassic clay. The contact metamorphism is due to intrusion of a large basaltic sill complex. High temperature (>600 °C) metamorphism produced zoned mineral assemblages around the fossils due to reaction between the calcite and calcite /pyrite shells and the clay matrix. The metafossils comprise an inner wollastonite-rich core that also contains pyrrhotite and fayalite in the ammonites (zone 1), surrounded by iron-rich wollastonite, hedenbergite, titanite, and plagioclase (zone 2). The matrix in contact with the metafossil (zone 3) comprises magnesian hedenbergite, plagioclase, and potassium feldspar, and matrix distant from the fossils (zone 4) comprises augite, plagioclase, potassium feldspar, fayalite, and Fe-Ti oxides. The metamorphic reactions, in particular the reaction of calcite with silica-bearing fluids to form wollastonite and the transformation of pyrite to pyrrhotite, result in large volume changes that may have distorted the shape of the fossils. Nevertheless, original morphological features, particularly of the ammonites, can be detected.

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