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## NEW OCCURRENCE OF EXCEPTIONALLY PRESERVED FOSSILS IN THE MIDDLE CAMBRIAN OF HUNAN, CHINA: SIGNIFICANCE WITH RESPECT TO GLOBAL CORRELATION

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Remains of exceptionally preserved fossils are present in some thinly laminated, dark lime mudstone beds of the Huaqiao Formation as exposed in the Paibi section, northwestern Hunan Province, China. Here, we report the occurrence of a hydroid, and fragmentary remains of probable bacteria or algae, from near the top of the *Ptychagnostus atavus* Zone (upper Middle Cambrian). This new occurrence is the youngest Konservat-lagerstätte within the Cambrian of China, and it is one of the youngest non-concretionary deposits of exceptional preservation from the Cambrian globally. In contrast to deposits of the Lower and Middle Cambrian, where more than 40 nonconcretionary Lagerstätten are known (Conway Morris, 1985; Babcock *et al.*, 2001), Cambrian deposits younger than the *P. atavus* Chron yield few exceptionally preserved fossils except in limestone concretions. The new occurrence is of special significance because it occurs in the upper part of the Middle Cambrian, in a stratigraphic section under consideration for placement of a global stratotype section and point (GSSP).

A single, fragmentary but well-preserved cnidarian hydrocaulus, approximately 1 cm in length, is referred to *Archaeocryptolaria* (Hydrozoa: Calyptoblastea). The specimen is slender, slightly flexuous, and with nearly cylindrical hydrothecae that narrow slightly at their bases. The periderm is wrinkled in places. The specimen appears to be preserved by carbonization; the central stalk is preserved in relief. The new occurrence in Hunan represents a range extension for the genus. Previous to this report, *Archaeocryptolaria* was known only from Victoria, Australia, where it occurs at some localities with trilobites reported (Chapman and Thomas, 1936) to be of early Middle Cambrian age.

At least five types of presumed algae or bacteria are represented in the lower part of the Huaqiao Formation at Paibi, Hunan. All of these forms appear to be preserved as carbon films, although subtle relief is present in some specimens. 1, Long, non-helical tubes, up to 2 mm in width, appear to be stipes of the presumed chlorophyte alga *Yuknessia*. *Yuknessia* is locally

abundant on some bedding planes. These specimens are the youngest *Yuknessia* known from the Gondwanan region (including the tectonic plates that comprise China); it is comparable in age to congeners from Laurentia, where it occurs as high as the *P. atavus* Zone in the Wheeler Formation of Utah, USA (Robison, 1991). 2, A slender, helically coiled, bacterial? stipe that is less than 0.5 mm wide is tentatively referred to *Megaspirella*. In this form, coiling of the stipe ranges from loose to tight. If this is *Megaspirella*, it represents a significant range extension; *Megaspirella* was previously known only from the Early Cambrian (late Atdabanian or early Botomian) Chengjiang Biota (Chen and Erdtmann, 1991; Chen *et al.*, 1996). 3, A single specimen represented by slender, slightly twisted, stipes more than 15 mm in length, is similar to the cyanobacterium *Marpolia*. The stipes are less than 1 mm wide and have elongate striations. 4, Ovoid bodies up to 2.5 mm in width, are referred to the cyanobacterium *Morania*. *Morania* is locally abundant on some bedding planes. Similar to *Yuknessia* from the same interval of the Huaqiao Formation, the presence of *Morania* compares closely with the uppermost observed range of the genus in Laurentia (Wheeler Formation, *P. atavus* Zone, of Utah; Robison, 1991). 5, A possible alga is represented by more than one dozen ovoid bodies ranging up to 7 mm in diameter. Some specimens have concentric wrinkles.

Present indications are that the Huaqiao Lagerstätte is comparatively minor in terms of the number of exceptionally preserved specimens and the number of species preserved in exceptional condition. Nevertheless, the occurrence is of considerable importance because of the preservational conditions it represents. Regional stratigraphic relationships suggest that the Huaqiao Formation was deposited in a slope environment adjacent to the South China Platform (Peng, 1992). The Huaqiao occurrence is unusual among Cambrian deposits because exceptionally preserved fossils occur in nonconcretionary limestone. The dark gray to black color of the thinly laminated lime mudstone suggests dysoxic to anoxic conditions at or near the sediment-water interface at the time of burial; low oxygen conditions may have, at times, extended into the water column. Burrowing organisms and scavengers seem to have been at least temporarily excluded from the depositional site, probably largely as a result of inimical chemical conditions in the seawater (see Babcock *et al.*, 2001, and references therein). Overall, the style of preservation exhibited by the algal or bacterial remains seems similar to that in parts of the Wheeler Formation of Utah, where carbonized remains of algae or bacteria are locally abundant on some bedding planes of dark gray, thinly laminated lime mudstone.

The Paibi section is under consideration for placement of the Middle-Upper Cambrian boundary (Peng and Robison, 2000). The likely position of the boundary is within the Huaqiao Formation, at the base of the *Glyptagnostus reticulatus* Zone. This position occurs more than 100 meters upsection from the occurrence of exceptionally preserved, nonmineralized fossils reported here, and thus does not bear directly on the choice of a boundary stratotype. Nevertheless, this report emphasizes the fine preservational quality of fossils from the Huaqiao Formation at Paibi. This, together with the diverse shelly biota recorded from the section (Peng

and Robison, 2000, and references therein), serves to indicate that this section preserves one of the most complete records of Cambrian life forms through the upper Middle Cambrian-lower Upper Cambrian interval. This occurrence also opens the possibility that other fossils of nonmineralizing organisms have been preserved in, but are as yet unreported from, higher stratigraphic levels in the Huaqiao Formation in northwestern Hunan.

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