Fossils from Gabon show early steps toward multicellularity 2.1 billion years ago

PRESS RELEASE

Animals appeared a little more than half a billion years ago, changing the Earth's biosphere forever. Predation, burrowing, and all other modes of life available to animals pushed evolution in numerous directions. This was the "Cambrian explosion".

Animals were not the first, nor the only, multicellular organisms, however. Scattered fossil occurrences show that large individuals using cells as building blocks appeared a number of times during the latter part of the Proterozoic Eon (2.5 to 0.54 billion years ago). Some of these early lineages (such as red or green algae) still exist.

Reported in this week's issue of *Nature* Magazine is the recent discovery of centimeter-sized fossils from black shales in Gabon. These fossils reveal that large organisms growing in a coordinated manner (a prerequisite for multicellularity) go back to at least 2.1 billion years ago, almost to the beginning of the Proterozoic Eon. The fossils were investigated by an international team of scientists, led by Abderrazak El Albani of the University of Poitiers, France.

On the surface, the fossils resemble irregularly shaped cookies with split edges and a lumpy interior (Fig. 3, left). Viewed in a high-resolution X-ray tomograph (a kind of CAT scan) they reveal a sheet-like structure with a pervading radial fabric and a neat pattern of central folds (Fig. 3, right).

This structure is too complex to be a product of inorganic processes, and further analyses confirmed that the carbon in the fossilized tissue was assembled by biological processes, also that the fine-grained "fool's gold" (the iron-sulfide mineral pyrite) replacing most of the tissue had been formed by bacteria "breathing" sulfate, rather than oxygen, when decomposing the organisms in the sediment. Finally, the organisms were shown to have lived in shallow marine waters with free oxygen.

Large size generally signifies an energy-demanding way of life. Breathing oxygen, as we do, is a much more efficient way of obtaining energy than other physiological processes. The Proterozoic Eon saw two major events of oxygen build-up in the atmosphere (and, thereby, in the oceans); the first near the beginning of the Eon, 2.45–2.2 billion years ago, and the second at the end, 0.8–0.54 billion years ago. The evolution of the Gabon fossils, representing an early step toward large-sized multicellularity, may have become possible by the first boost in oxygen, whereas the "Cambrian explosion" could have been fuelled by the second. Why it took 1.5 billion years for the multicellular organisms to take over is currently one of the great unsolved mysteries in the history of the biosphere.

* El Albani A., Bengtson S., Canfield D.E., Bekker A., Macchiarelli R., Mazurier A., Hammarlund E., Boulvais P., Dupuy J.-J., Fontaine C., Fürsich F.T., Gauthier-Lafaye F., Janvier P., Javaux E., Ossa Ossa F., Pierson-Wickmann A.-C., Riboulleau A., Sardini P., Vachard D., Whitehouse M. & Meunier A. - **Large colonial organisms with coordinated growth in oxygenated environments 2.1 Gyr ago**. *Nature*, 465, 1 July 2010.

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Fig 1. The site bearing the 2.1 Ga macrofossils outcropping near Franceville, in Gabon (© *El Albani*)

Fig 2. The fossil remains of the Gabonese colonial macro-organisms (© *El Albani*)

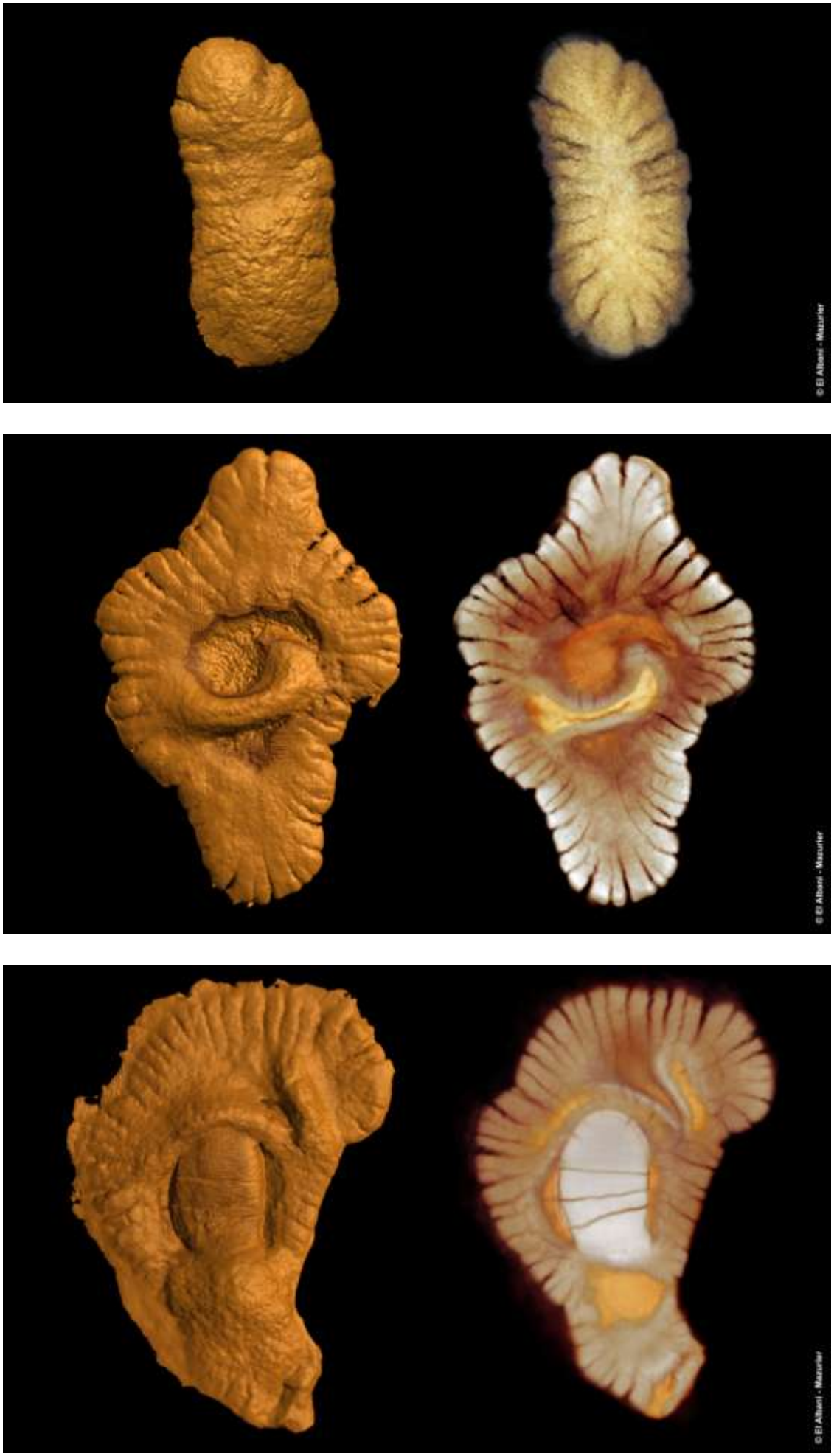

Fig 3. Virtual reconstruction (via microtomography) of the outer (left) and inner morphology (right) of three fossil specimens from the Gabonese site (©*El Albani - Mazurier*)