CRYSTALLOGRAPHIC TEXTURE OF THE GRYPHAEA DILATATA BIVALVE SHELLS

A.V. Pakhnevich[1,2], D.I. Nikolaev[2], T.A. Lychagina[2]

[1]*Borissiak Paleontological Institute of RAS, Moscow, Russia*
[2]*Joint Institute for Nuclear Research, Dubna, Russia*

E-mail: alvpb@mail.ru

In the seas of the Middle and Late Jurassic of the East European Platform, bivalve mollusks of the family Gryphaeidae were a frequently occurring fauna element. The most common were the species of the genus Gryphaea (Lamarck, 1801). The shells of these mollusks were large and thick-walled. At the same time, the left valve is strongly convex with a curved umbo, while the right valve is flattened. The thick-walled shell protected well from predators, withstood abrasion in shallow water due to wave activity; thickened walls coalesced better when beds were formed. Such a shell organization turned out to be very evolutionarily successful; therefore, the genus existed from the Late Triassic to the Paleogene [1]. A similar adaptation was also characteristic of the Cenozoic Gryphaeidae, and it also manifested itself within the closely related bivalve family Ostreidae.

It can be assumed that the thickened shell of fossil mollusks may have a more ordered crystallographic texture, which is necessary to preserve its integrity. The aim of this work is to compare the crystallographic textures of the bivalve mollusks Gryphaea dilatata Sowerby, 1816 from three remote localities formed under different diagenetic conditions.

Valves were taken from the Mikhailovsky quarry near the city of Zheleznogorsk (Kursk region) from the deposits of the Callovian stage of the Middle Jurassic. Valves collected in a quarry near the village of Sukhochevo (Oryol region) also originate from the Callovian deposits. Only the left valves of this species were found in the urban quarry in the town of Roshal (Moscow region). The complex of accompanying fauna was analyzed to determine the geological age. For comparison with G. dilatata, the left valve of Pycnodonte mirabilis (Rousseau, 1842) (family Gryphaeidae) was selected from the Cretaceous deposits of the Crimea, as well as recent (Maly Utrish coast, Black Sea; Portugal, port of Lagos) and Pleistocene (Arabat Bay of the Sea of Azov; Chushka Spit, coast of the Taman Peninsula) Ostrea edulis Linnaeus, 1758.

The crystallographic texture was studied by means of time-of-flight neutron diffraction at the SKAT facility at the Frank Laboratory of Neutron Physics (JINR, Dubna, Russia) [2]. It was analyzed according to the pattern of isolines on the pole figures and the numerical values of the greatest sharpness.

It has been established that the shells of G. dilatata from the Mikhailovsky quarry can be Middle or Upper Callovian. The gryphaea shells found near the village of Sukhochevo are Middle Callovian age, and those found in the vicinity of the Roshal town are among Callovian or Early Oxfordian age.

Only calcite was found in all valves. In terms of the maximum sharpness of the crystallographic texture, the shells of G. dilatata from the three localities almost do not differ, that is the habitat conditions and fossilization did not affect the texture, and it can be considered a very stable feature.

For the first time, using neutron diffraction and pole figures, the features of G. dilatata shells recrystallization that affect the crystallographic texture were revealed.

It has been established that in one mollusk the crystallographic texture of the left and right valves of various shapes differs: to a greater extent by the pattern of isolines, to a lesser extent by the values of maximum sharpness.

The calcite pole figures and the maximum sharpness of the G. dilatata left valves and those of O. edulis are similar. The pole figures and values of the maximum sharpness of the G. dilatata right valves are similar to the same parameters of the left valve of P. mirabilis. All

listed species are characterized by either an axial pole figure with a sharpness maximum in the center, or a figure with an arcuately curved sharpness maximum (Fig. 1). Possibly, it is the pole figures with such isoline patterns that are characteristic of thick-walled shells.

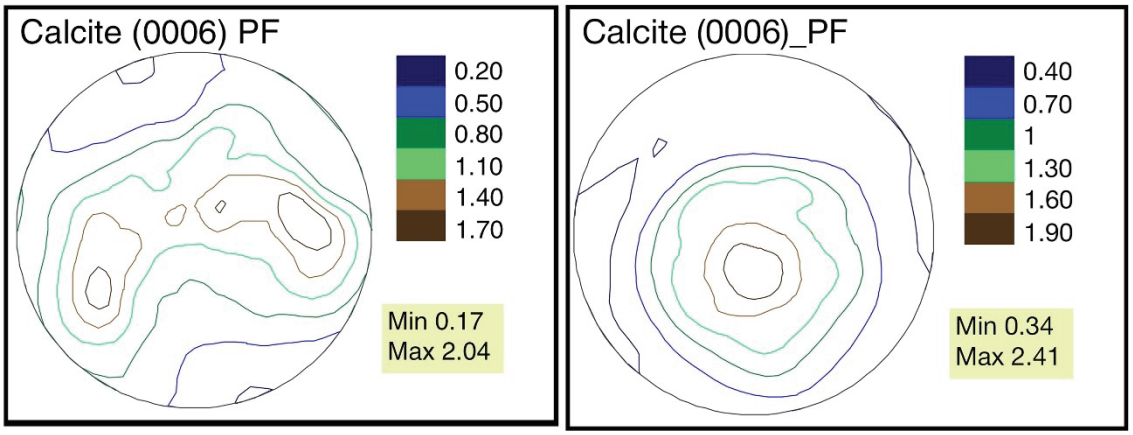

Fig.1 Pole figures of calcite in the left valves of Gryphaea dilatata (left) (Mikhailovsky quarry) and Pycnodonte mirabilis (right). The colour scale in the right top corner marks the intensity of isolines presented in units of random distribution (mrd).

The thick-walled valves of G. dilatata, O. edulis, and P. mirabilis have low values of the crystallographic texture maximum sharpness. These values are very close for these mollusks. Perhaps this is a characteristic feature of all thick-walled valves and reflects adaptation to shell construction, because more energy is required to build more ordered texture of a thick-walled shell.

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