FUNCTION OF WING PLATES IN PTEROTOCRINUS

№ 59213

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One of the most unusual groups of camerate crinoids is the Mississippian genus Pterotocrinus. The members of this genus are characterized by the presence of five large tegminal appendages known as "wing plates". It has been suggested that the wing plates were anti-predatory devices, food gathering appendages, hydrodynamic baffles or "snowshoes" for stabilization and support on the substrate. Here we suggest yet another alternative function: the wing plates were an adaptation to a rheophilic mode of life, allowing the crinoid to passively orient its crown and arms into an efficient feeding position.

Experiments performed in a recircularing water tank on models of Pterotocrinus depressus indicated that in moving water the most stable position of the crown was with the oral-aboral axis oriented parallel to water direction with the oral end pointing down-current. Any deflection resulted in the generation of a significant restoring force. This position of the crown corresponds to the parabolic filtration fan posture of modern stalked crinoids, in which feeding efficiency is maximized.

Modern crinoids actively manipulate their arms to achieve an efficient feeding posture. The limited flexibility of camerate arms, which were firmly incorporated into the calyx and lacked muscular articulations, suggests that the maintenance of a feeding posture had to be accomplished by a different mechanism. Our results indicate that the wing plates served that purpose.

The use of such a mechanism would not have required any expenditure of metabolic energy and may thus have been an attractive adaptive option for other crinoids. The modifications of the crown found among some camerates, the spines of Dorycrinus or the anal tubes of batocrinids, may represent similar solutions to the same problem.

THE BIOMECHANICAL INTERPRETATION OF AMMONITE SEPTA.

№ 59214

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Three major functional interpretations-or "paradigms"-of ammonite septa have been discussed extensively in the literature, particularly with regard to septal fluting: a) the fluting of septa increases the strength of the shell; b) fluting is related to the organic preform of the shell, and serves to stabilize the initial membrane; c) fluting of septa results from the fission of suture lines, which is itself related to the attachment area of muscle.

All these paradigms are capable of explaining part of the observations made on ammonite septa. However, no single one of the paradigms seems to be sufficient as the general explanation of septal fluting.

The biomechanical properties of the different paradigms will be briefly discussed, and then related to actual observations of septal morphology. A central point is made about abnormal septa and their role in the reconstruction of biomechanical properties.

THE SUBMERGED GLACIOFLUVIAL PALEODELTA OF THE KENNEBEC RIVER, WEST-CENTRAL MAINE COAST

№ 65839

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During 1983 and 1984 high resolution seismic reflection profiling has been used in an NSF and NRC-funded project to define late Pleistocene and Holocene sedimentary facies in the estuaries and nearshore Gulf of Maine. At the mouth of the Kennebec River off the west-central Maine coast 60 km of trackline cover a submerged sand and gravel body interpreted as the glaciofluvial outwash delta of the paleo-Kennebec. This convex-upward fan feature is 43 km^2 in surface area with steep margins on the east with a relief of up to 30 m above the adjacent mud-floored channels. The surface is sand and gravel, as confirmed by submersible reconnaissance. High resolution 3.5 kHz and ORE-Geopulse boomer records define a prism of stratified sand and gravel with foresets and probable topsets. The prism overlies a rugged bedrock terrain and averages 25 m thick, locally reaching over 65 m in thickness. In bedrock lows, the coarse sediments overlie an acousticaly more homogeneous unit which drapes underlying bedrock, interpreted as the glaciomarine Presumpscot Fm. This sand and gravel lithosome is interpreted as the paleodelta of the ancestral Kennebec River, emplaced on the present seafloor at the time of sea-level lowstand between 10,000 and 9,000 (?) yrs. B.P. Relative sea level dropped to approximately 50-70 m below present due to rapid post-glacial isostatic rebound. The Kennebec River paleodelta is similar to the -47 m lowstand Merrimack River paleodelta off New Hampshire, described by Oldale et al. (1983). The delta formed from abundant deglacial outwash available in the Kennebec River system. Subsequent Holocene relative sea-level rise caused the shoreline to retreat rapidly across the delta surface, reworking sands into barrier spit and pocket beaches which now form the Small Point, Popham, and Reid State Park beach system, unique in this part of the coast.

THE SILURIAN SMALLS FALLS FORMATION IN SOUTH-CENTRAL MASSACHUSETTS AND ADJACENT CONNECTICUT

№ 69073

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The Smalls Falls Formation in central Massachusetts, previously known as the White Schist Member of the Paxton Formation (with the map symbol Spsq), is sillimanite-pyrrhotite-graphite schist with subordinate interlayered 2- to 20 cm-thick quartzite beds. It contains pale to white (Mg-rich) biotite and ubiquitous rutile. These distinguish it from other sillimanite-pyrrhotite-graphite schists which contain dark biotite, ilmenite, and garnet. Outcrop surfaces of the Smalls Falls Formation are commonly coated with a dark purplish to orange-brown weathering rind and have elongate pits up to 5 cm deep caused by pyrrhotite weathering.

Nearly certain correlation of the White Schist Member with the Silurian Smalls Falls Formation of western Maine is based on the distinctive, extremely magnesian silicate composition and on the sequence of rock types. Locally, the Smalls Falls lies between the Granulite Member of the Paxton Formation (=Madrid?) and feldspathic, sillimanite-pyrrhotite-garnet schist with interlayered thin calc-silicate granulite (=Rangeley?). In many places, however, this complete sequence is not present due to structural complications.

On the 1983 Bedrock Geologic Map of Massachusetts, unit Spsq extends in a stringy pattern from Templeton southward into a region of granulite facies metamorphism to a point 6 km south of the Massachusetts Turnpike. Detailed mapping in progress in the Warren (Mass.) and Wales (Mass.-Conn.) quadrangles shows that this unit is more extensive and in more belts than previously known. At least one of the belts extends into Connecticut. The map pattern of the distinctive Silurian Smalls Falls Formation will be the key to understanding the structural geology in this part of south-central Massachusetts and adjacent Connecticut.

LAVA-SEDIMENT INTERACTIONS: THEIR ROLE IN MELANGE FORMATION

№ 58138

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Stratigraphic and sedimentologic relationships in mixed volcanic-sedimentary encironments are complicated by the various interactions between hot lava, wet sediment, and sea water. The development of hyaloclastites is one such complication that is fairly well understood.

In the Gwna melange of North Wales, several other phenomena can be documented. Slumping of sediment was engendered by local increases in pore pressure above sills. Fluidized carbonate mud became the matrix for breccias of pillows and pillow fragments. Circulation of the hot pore fluids replaced complete pillows and pillow fragments with carbonate while preserving the original texture. In addition, the volcanics were local sources of detritus which produced complicated variations in sand composition within the Gwna Group.

These structural and stratigraphic variations have been interpretted as indicators of the character of the Gwna melange. The deformation and mixing by these processes is non-tectonic. The volcanogenic horizons provide a coherent stratigraphic marker that indicates that a major exposure of the Gwna Group is stratigraphically coherent and that most of the deformation can be attributed to synsedimentary gravity processes.

DEGLACIATION OF NORTHWESTERN MASSACHUSETTS

№ 59277

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Field mapping in the Berkshire mountains of Massachusetts shows that retreat of the Laurentide ice sheet occurred by downwasting over the highlands and by stagnation-zone retreat in the valleys. Striations and streamlined features indicate ice-flow direction from 320° to 340°, oblique to major valleys that trend north or west. Ice-contact and glacialfluvial deposits are found primarily below 1700' on the lower valley walls and valley bottoms whereas till mantles upland outcrops of schist, phyllite, and quartzite. Some areas below 650' expose stratified fine-grained materials indicative of lacustrine deposition. Our studies suggest that northward-retreating ice ponded a glacial lake (Lake Bascom), which fell from an initial level of about 1050' to 1000' as erosion lowered a spillway at the SE corner of the lake. Lake Bascom stabilized for a short time at the lower spillway elevation. As the retreating ice tongue uncovered successively lower outlets to the NW, the lake drained into the Hudson Valley and lowered through several stages to a final elevation of about 450'.

Evidence for moraines is sparse; ice-contact zones, outwash heads and the position and elevation of ice-marginal drainages are used to reconstruct the history of deglaciation. Levels of L. Bascom are determined from the altitudes of deltas built into successive stands. Delta volumes suggest that ice-retreat was rapid and that L. Bascom probably persisted less than 500 years. Upwarping of water planes since deglaciation give a gradient of 0.5-0.8 m km^{-1}.