Swarm cells of slime molds in sexual conjugation from sixty-five million year old sediments, Madhya Pradesh, India

Swarm cells of slime molds (Myxomycetes) in solitary or conjugating stages are reported from the Deccan intertrappean beds (Maastrichtian) of Padwar, Madhya Pradesh, India.

Sexual intercourse enhances the gene pool of the future generations, which is manifested in the innovation of new characters to cope with the external and environmental pressures. The sexual organs being delicate and the time of conjugation short-lived, it is indeed rare to get this stage in the fossil state. However, some sixty-five million year old slime molds could be recovered from the Deccan intertrappean bed at Padwar near Jabalpur, Madhya Pradesh, while in copulation.

Slime molds are generally placed under the fungi by mycologists, while zoologists place them in the order Myxogastrea, subclass Mycetozoa and phylum Protozoal. Though inconspicuous in appearance, slime moulds have many stages of life cycle, comprising three types of unicellular organisms, among which one is flagellate, one multicellular somatic phase, a resistant stage and finally a reproductive phase.

The slime molds were recovered from a dry dug-out well at Padwar. The well is approximately 9 m deep and has basaltic rocks at the base and top. The basal basalt is overlain by about 1.5 m thick grey-carbonaceous/shale, which is covered by more than 3 m thick volcanic ash bed. An approximately 2 m thick grey-carbonaceous shale layer is sandwiched between the ash bed and the upper basaltic rock (Figure 1). The intertrappean sediments were deposited in water bodies formed due to the obstruction of drainage channels, during the lull period of Deccan volcanism.

The palynological assemblage of the clastic sediments has been divided into a lower Aquilapollenites bengalensis zone and an upper algae-dominant zone. The presence of Azolla cretacea Stanley, Arlaudinaeoporia arlaudiana (Miner) Potonie, Gabonisporites vigourouxii Boltenhagen and Aquilapollenites bengalensis Banks and Deb in the lower zone indicates a Maastrichtian age for the sediments. The slime molds recorded here come from the highly carbonaceous/lignitic samples (P1-P3) of the A. bengalensis zone (Figure 1). These comprise solitary swarm cells, swarm cells in sexual conjugation, spores and zygospores; however, only swarm cells are reported here. These palynomorphs were recovered by means of maceration of the samples by commercial nitric acid (40%), followed by a wash of potassium hydroxide solution (5%).

Swarm cells are biflagellate and common in the samples. Two types of swarm cells are observed. In the first type, flagella are about 200 μm long, narrow,
Figure 1. Locality, litholog of the well and position of the samples (after Sahni et al.10).

Figure 2. Swarm cells of the slime molds (Mycxomycetes). a. Solitary swarm cell with two flagella; b. Two swarm cells in sexual conjugation, one showing a branched flagellum; c. Flagella of swarm cells lost of nascent zygospore; d. Flagella of two swarm cells placed in opposite direction and most of the parts lost.
lower part slightly broader, and the rest more or less uniformly broad. Lateral hairs are absent, two flagella are of equal length, sometimes they are branched, may be lost in maceration; body of swarm cells is of two types, one is subcircular, 8–15 × 6–12 μm, laevigate, sporting flagella in the opposite direction. In the other type, the central body is conical, funnel-shaped, broader on one side and tapering at the other (Figure 2a, b).

The second type has swarm cells more or less of equal size, 10–18 × 8–16 μm, the flagella are robustly built, opposite to each other, 210–320 μm in length and 5–12 μm in breadth, laevigate, without any hair at the basal part; flagella are shed gradually after zygote formation (Figure 2c, d).

The specimens recorded here are not closely comparable to any fossil forms. Some flagellate structures recorded from the two billion year old Precambrian rocks of the Canadian Shield are devoid of such kind of body and flagella of the swarm cells. Flagella are formed for movement of zoospores and gametes in Myxomycetes and some members of Phycocyanetes. Flagella are basically of two types: tinsel and whiplash. In the former, lateral hairs are present at the lower part of the flagella, whereas in the latter they are absent.

The gametes are generally divided into four types on the basis of flagella. In Chytridiomycetes, Blastocladiomycetes and Monoblepharidales, a whiplash-type of flagellum at the posterior end is observed. The tinsel-type of flagellum at the anterior end is characteristic of the Hypocymiumycetes, whereas in the Oomycetes, one tinsel and one whiplash type of flagella are observed. Two flagella of both whiplash types are observed only in the Myxomycetes and Plasmodiophoromycetes. In the latter, the two flagella are remarkably unequal in size, whereas in the former, the two flagella are of the same size. Thus in all probability, the specimens detailed here belong to Myxomycetes.

The members of this phylum are adapted to grow under varying environmental conditions, be it the Antarctic or the desert. The Myxomycetes were reported from India since 1830 onwards, but there are no reports on the fossil form. They are common during the rainy season, are shade-loving and grow well under dead wood, leaf litter and cracks. The specimens recovered here were from the highly carbonaceous lignitic shales, indicating their choice for the rotten debris. There was abundance of water as the specimens were growing in a lake. It is supposed that presence of water encourages the formation of motile swarm cells.


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