Desiccation cracks: microbially induced compared to sterilized sediment

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Microbially Induced Sedimentary Structures (MISS) represent a novel group of primary sedimentary structures that are produced by microbial and algal interactions with sedimentary substratum. Sediment covered with a microbial mat, where grains are bound by bacterial filaments and mucous-like extracellular polymeric substances (EPS), responds differently to physical stresses resulting in sedimentary structures with distinct morphologies which can be identified in the geologic record as microbially induced. A series of desiccation experiments were carried out to determine differences between microbially induced desiccation cracks and those formed in identical, but sterilized siliciclastic sediment. Three sediment mixtures were used: (1) very fine-sized sand, (2) mixed silt/clay and (3) normally graded silt/clay. The water-rich biomat was observed to contract tremendously while drying, producing isolated pockets of shallow, wide radiating cracks, distribution of which was controlled by lateral heterogeneities in the mat structure and vertical thickness limitations. In the sand substrata, biomat was the only crack-forming mechanism. In the clay-rich sediment, shrinkage of the more abundant clay controlled the resulting crack network, while the biomat showed ability to interfere with the clay-induced cracking by bridging some of the cracks or producing curled-up crack polygon margins. This differed from the desiccation of the homogeneous abiotic clay-rich sediment, which resulted in a regular network of deep cracks intersecting at 90 - 120^{o} junctions. The abiotic crack polygons had flat-laying margins in the mixed silt/clay sediment and concave-up margins in the mixed silt/clay sediment. Data indicate that the most unique indicator of microbial influence on cracking is the heterogeneous distribution of isolated, wide and shallow cracks that do not connect to one another. Even though a microbial mat has the ability to shrink immensely with desiccation, its cohesive nature prevents formation of a regular crack network.

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