

Lacustrine Stromatolites and Microbialites as Petroleum Reservoirs

Buchheim, Paul ¹; Awramik, Stanley ²; Leggitt, Leroy ¹ (1) Department of Earth and Biological Sciences, Loma Linda University, Loma Linda, CA. (2) Department of Earth Science, University of California, Santa Barbara, CA.

One of the largest oil fields in the Uinta Basin, Utah, is sourced from a thick lacustrine microbialite/oolite bioherm, 30 m thick and 4 km long, that has produced close to a million barrels of oil. Outcrop exposures of analogous bioherms occur in the Piceance Creek Basin of Colorado and in the Green River Basin of Wyoming. These occurrences provide analogs for exploration of petroleum in other lake basins. Recent exploration in the "pre-salt" lacustrine sections of off-shore Santos Basin of Brazil suggest that microbialites and associated lacustrine facies form significant reservoirs (Mello et al., 2009).

Microbialite bioherms from the La Barge area in the Green River Basin of Wyoming provide excellent outcrop analogs. The bioherms occur in the Wilkins Peak Member of the Green River Formation and are composed of clusters, some approaching 0.5 km across, of domical and columnar stromatolites. Individual stromatolites in the clusters are up to 3 meters in diameter. Ooids, oncoids, calcified caddisfly larval cases, and other carbonate components occur within and between the stromatolites. Laterally, bioherms are discontinuous (like patch reefs); however, the lake-margin bioherm system is found in a large arc (over 250 km) across the western, northern, and eastern greater Green River Basin. Bioherms grade laterally into adjacent fine-grained lake facies over a distance of 100 meters and into dolomitic oil shale of the Wilkins Peak Member over a distance of ~15 km.

Since thick microbialites can be important reservoir rock, it is important to understand the paleoenvironmental conditions that favor the formation of bioherms over biostromes. In the southeastern part of the Green River Basin, biostromes seem to be the exclusive megastructure of microbialites, whereas in the northwest to northeast part of the basin bioherms occur in addition to biostromes. The biostromes are found in sequences interpreted to be balanced-filled lake deposits where regressions and transgressions over very low gradients were frequent. Bioherms appear to have been favored by under-filled lake-basin conditions (saline-alkaline lakes), where localized fresh-water deposition was restricted to the lake margins.

The importance of lacustrine microbialites as petroleum reservoirs is significant and their potential for petroleum exploration in lacustrine basins cannot be under estimated.