CYANOBACTERIAL MATS AND OTHER BACTERIA: MAJOR CONTRIBUTORS TO THE FORMATION OF THE LOWER CRETACEOUS TOOLEBUC OIL SHALES

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BIOGRAPHY

Miryam Glikson graduated with a M.Sc. in Geology and Biology from the University of Jerusalem, prior to undertaking post-graduate studies in palynology at the University of Western Australia (Hackett Scholarship). She was involved in research work at the Research School of Pacific Studies until 1975, and is currently a Ph.D. student at the Centre for Resource and Environmental Studies, Australian National University.

SUMMARY

The oil shales of the Toolebuc Formation consist of irregularly spaced calcareous laminations alternating with black organic-rich laminae - suggestive of "algal-mats". Cyanobacteria of Nostoc and Anabaena types were encountered in SEM observations of whole-rock fragments. TEM observations of the organic matter (OM) concentrates revealed a wealth of microbial remains. These bacteria were most likely responsible for the degradation of the primary OM leading to the production of the amorphous OM that is visible with optical microscopy. The so-called 'amorphous OM" in TEM observations consists of mesh-structured "palaeoproteins", humic acids and more or less homogenous OM of lipidic nature.

The ^{13}C values of the OM from the laminated oil shales gives values of -27.8% to -29.0%, indicating a bacterial lipid source as the major contributor at the final stage of deposition.

High concentrations of the trace metals vanadium, molybdenum and nickel are associated with the oil shales. The higher accumulations of molybdenum were found to be present in samples with a high organic nitrogen content. A dependancy of N-fixing cyanobacteria on the presence of molybdenum has been previously demostrated.

The presence of pyrite within the calcite indicates that $CaCO_3$ was deposited in the anoxic zone. The irregularity in extension and dimensions of the calcareous laminae is not compatible with seasonal precipitation. It is more likely to be the result of microenvironmental changes brought about by the cyanobacteria upon reaching high densities which led to depletion of the nitrogen source and to their subsequent death.

The wealth of planktonic foraminiferal and coccolith remains suggests a highly productive aerated upper water layer and an anoxic water-sediment interface as evident from the abundance of pyrite within the remains of organisms as well as in the surrounding matrix.

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