Seeing the Forest but not, until recently, the Trees: Understanding Marine Snow as a Building Block of Organic Carbon Rich Mudstones -- A Presentation in Honor of Ken Bird

Keller, Margaret A.[*1]
(1) Western Geology&Geophysics, US Geological Survey, Menlo Park, CA.

Many contributions to understanding the petroleum systems of Alaska and adjacent areas have been made over the past 30+ years by the USGS Energy Program's projects led by Ken Bird with multiple collaborators from the United States and abroad. In 1996, I began working with Ken on petroleum source rock characteristics and variation on the North Slope because the total amount of petroleum generated in the region was uncertain due to unknowns about the original endowment of source rocks -- both laterally and through time. This presentation covers two approaches used -- log analysis for the bigger picture, and petrography, geochemistry, and SEM for identifying the fundamental components and fabrics of these fine-grained rocks -- essential for understanding their origin and potential.

Using geophysical well logs and the algorithms of Passey and others (1990), our first project was regional analysis of organic carbon richness and thickness of major petroleum source rock intervals in siliciclastic systems of the Jurassic-lower Tertiary, including the Kingak Shale, pebble shale unit, and Hue Shale. The resulting log-based TOC profiles provided both organic richness and thickness estimates for individual potential source intervals throughout the North Slope. In turn, these contributed to better estimates of the amount and location of generated hydrocarbons in subsequent petroleum systems modeling.

Early in our studies, it became clear from new pioneering research on mudstones in England that we knew very little about the basic composition and fabrics, and therefore origin of the petroleum source rocks in Alaska. Thus began field studies in the ANWR in 1997, and subsequent core collecting, petrographic, and geochemical analysis of the Lower Cretaceous, organic carbon-rich mudstone succession of the North Slope with J. Macquaker, K. Taylor, P. Lillis, and others - endeavors always greeted with enthusiasm by Ken Bird. These studies document diverse compositions and fabrics for abundant sub-mm organo-mineralic aggregates in this succession, which we propose are ancient equivalents of modern marine particle aggregates or marine snow -- the main mechanism for sediment delivery to the modern seafloor where sedimentation isn't dominated by siliciclastic inputs. Additional textural data indicated that much of this mudstone succession was deposited from melting, sediment-laden, seasonal sea-ice -- a new idea for its origin and for organic carbon-rich sedimentation for this, and probably other parts of the circum-Arctic region.