

Technical Luncheon – Reservoir & Production
Tuesday March 9, 2010
11:45 a.m. to 1:00 p.m. – Doors will open at 11:15 a.m.

ConocoPhillips Auditorium, Calgary
401 – 9 Avenue SW, 3rd Floor, Gulf Canada Square

Cap Rock Integrity and Geological Risk Assessment for the Athabasca Oil Sands and Development Strategies

Presented by: Fran Hein, Ph.D., P.Geol.
Energy Resources Conservation Board

Alberta's largest bitumen deposit is hosted mainly in Cretaceous Athabasca oil sands deposit near Fort McMurray. For all oil sands areas, the bitumen reserve/resource estimates are a measure of the geologic as well as economic risk. Operators must deal with varying degrees of reservoir complexity depending on the oil sands area, bitumen deposit and depositional environment. In the Athabasca deposit, cut-and-filling of many incised valley fills occurred within a low-accommodation area on the sub-Cretaceous unconformity. The preserved stratigraphy was further complicated by interactions between localized salt-dissolution tectonics and rising eustatic sea-level. In some areas the relative base level fell, with removal of significant portions of the stratigraphy; elsewhere, relative base level rose, with enhanced preservation of local stratigraphy. These original geological processes resulted in extreme bitumen reservoir heterogeneity in certain portions of Athabasca. In addition to the inherent original bitumen reservoir heterogeneity are other geologic events that have to be assessed for in situ and mining development in Athabasca. Such geologic processes relate to tectonism (glacial-, karst-, or basement related); development of pre-, syn- and post-depositional karst; and the incision of Quaternary channels down to bedrock.

Besides the quality, complexity and occurrence of the bitumen reservoirs there are several factors to be considered when developing the bitumen resource in the Athabasca oil sands area. Combinations of mapping parameters such as overburden thickness, mass percent bitumen, minimum pay thickness, occurrence of bottom water, and lateral or top thief zones allow for the integration of the geologic framework with development scenarios. In general the oil sands are shallow reservoirs. The implications of this are that overburden pressures are low, and in some areas Quaternary channels may incise into the overlying caprock resulting in a compromised reservoir seal or allowing fresh water to be associated with bitumen. For the in-situ development areas of the Athabasca oil sands, bitumen reservoirs may be overlain by marine silty mudstones/fissile shale; in some areas breached by Quaternary aquifers. Other deeper freshwater subsurface reservoir may connect with bitumen reservoirs, mainly in areas adjacent to the Paleozoic highlands along the sub-Cretaceous unconformity. In addition, due to salt dissolution of the underlying Prairie Evaporites, has resulted in salt 'roll-over' and anticlinal structures, younger paleokarst, and local faulting.

Present ERCB mapping and reservoir characterization of the Athabasca oil sands deposits relies on integration of regional geologic frameworks with local geological risk features of the different oil sands project areas. Such an integrated approach allows for the proper assessment of different development scenarios for the efficient development of these vast resources.

Fran Hein is a Senior Geological Advisor at the Calgary office of the Energy Resources Conservation Board of Alberta, where most of her work has been on oil sands and coordinating the Ultimate Gas Potential project. Prior to that she was in charge of the oil sands program at the Alberta Geological Survey in Edmonton, Alberta. Most of Dr. Hein's career was spent teaching at various universities. She has authored/co-authored over 100 publications, including two textbooks, and has served as editor and associate editor for various scientific journals. She is presently on the Board of Directors for the CHOA (Technical) and is Vice-President and Oil-sands Chair for the Energy Minerals Division of the American Association of Petroleum Geologists. She obtained her B.Sc. degree from the University of Illinois at Chicago, and M.Sc. and Ph.D. degrees from McMaster University in Hamilton, Ontario, all in geology.