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Heavy mineral analysis of sandstones from reservoir and source rock units of Prudhoe Bay oil field, Northern Alaska.

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The Sadlerochit and Shublik Mountains, c. 100 km SE of the supergiant Prudhoe Bay oil field, contain the nearest exposures of its reservoir and source rock units. The Lower Triassic Ivishak Formation comprises a southward prograding and fining deltaic succession, whose upper, fluvial unit (Ledge Sandstone Member) is the primary reservoir of the oil field. The Ivishak was probably shed from a collisional belt composed of Lower Paleozoic and Proterozoic rocks now beneath the Beaufort Sea to the north, but little is known about these rocks because the Ivishak is compositionally mature and its source area may have been rifted away by the opening of the western Arctic basin in the Early Cretaceous. The Permian Echooka and Triassic Shublik Formation-Karen Creek Sandstone are transgressive units that underlie and overlie the Ivishak, respectively. The Shublik is the primary source rock unit for the Prudhoe Bay hydrocarbon accumulation. To better understand the nature of the mountain belt from which these deposits were derived, we are conducting a reconnaissance study of the heavy mineral (HM) composition of their sandstones. Samples were collected from the Ivishak Formation in the Sadlerochit Mountains from sections at Marsh Creek and the Nularvik River, in the Shublik Mountains at Fire Creek, and on the north flank of the Third Range. The samples are from topset strata (Ledge Sandstone and Fire Creek Members of Ivishak) and clinoform strata (Kavik Member). Transgressive deposits were sampled at Marsh Creek (Echooka) and Fire Creek (Shublik and Karen Creek).

Thirteen Triassic Ivishak samples (five from Marsh Creek, five from Fire + Karen Creeks, two from the Nularvik River, and one from the Third Range) and one Permian Echooka sample were analyzed by **Q**uantitative **E**stimation of **M**ineralogy using **Scan**ning electron microscopy (QEMSCAN) in two ways: whole-rock chip and mineral separate [1]. The Echooka HM assemblage includes abundant apatite (ap)+rutile/anatase (rt)+tourmaline (tur)+zircon (zrn). The Ivishak is dominated by ap, rt, tur ±chlorite (chl) ± zircon (zrn), but the base of the section (lower-Kavik) has notable chl. In the upper-Kavik chl is lost, rt+tur increase, and minor chrome-spinel (c-spl) is present. Samples of the lower Ledge have differing proportions of ap+rt+tur+zrn+minor c-spl, while the upper Ledge is dominated by tur (50%) with lesser ap+rt+zrn and minor c-spl. The uppermost part of the section (upper Ivishak and Shublik) is dominated by ap (45-80%), chl+rt+tur and minor zrn. While the two preparation methods yield similar *HM trends* and substantiates the efficacy of QEMSCAN analysis, we note significant differences in *absolute HM abundances* between the two preparation methods.

HM index ratios [2] were used to reduce differences between the two methods and are in good agreement. The rt/zrn index is uniformly high across the study area indicating an ultra-stable HM assemblage and consistent with sandstone maturity. The ap/tur index decreases significantly up-section in Marsh Creek consistent with the loss of ap due to diagenesis/weathering at this location. Future work will integrate optical quantification in order to better evaluate HM variation in the Ivishak Formation,

and thereby evaluate the provenance characteristics of the source area of the Ivishak-Shublik depositional system.

References:

[1] Morton & Berge (1995) Pet Geosci 1:355-364
[2] Morton & Hallsworth (1994) Sed Geol 124:3-29