

Molecular Composition of Crude Oil Stains From Bowser Basin:

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Introduction:

Three petroleum stains, that are either residual stains in breached oil fields or natural seepages, in Bowser Basin have been compositionally characterized using standard organic geochemical methods at the GSC's national organic geochemical laboratory in Calgary. Two extracts are from different modes of occurrence with variable petrographic characteristics in a single hand specimen. Petrographic details of those two extracts #9693 and #9694 are discussed by Osadetz et al. (2003). The results are presented for gross composition, saturate fraction gas chromatography, saturate fraction biological markers and aromatic hydrocarbon fraction molecular compositions. The results are not generally interpreted (e.g. Osadetz et al. 1994), but standard compositional ratios are suggested and may be computed from the data that is provided (for additional significance of these parameters and compounds see Peters and Moldowan, 1993). However, the results clearly show that the crude oil in the two Tsatia Mountain section extracts are similar and probably derived from a late Paleozoic to Triassic carbonate marine source rock deposited in a mesohaline to hypersaline environment of deposition, suggesting that the source of this oil occurs in the underlying Stikine Assemblage succession. In contrast the third extract from near the Triangle Zone of the Skeena Fold Belt is clearly derived from a Mesozoic clastic marine source rock, as would be expected from sources in the Spatzisi Formation or the Bowser Lake Group and younger successions. Detailed interpretation will be presented later, elsewhere.

Sample Identification and Location:

The geographic and stratigraphic position of these three samples are:

[Solvent Extraction #9693 GSC Calgary sample C-428547](#) collected at Tsatia Mountain reference section, NAD 27 Zone 9V, E442468 N6380068 from the Muskaboo Creek Assemblage, Bowser Lake Group, specifically, vein-filling material in an ammonite fossil in a shoreface sandstone.

[Solvent Extraction #9694 GSC Calgary sample C-428547](#) collected at Tsatia Mountain reference section, NAD 27 Zone 9V, E442468 N6380068, from the Muskaboo Creek Assemblage, Bowser Lake Group, specifically, a shoreface sandstone hosting the ammonite fossil that gives Solvent Extract #9693.

[Solvent Extraction #9731 of GSC Pacific Sample number GAE-86-314](#) collected near the confluence of the Buckinghorse and Spatzisi rivers at NAD 27 Zone 9V, E 525689 N 6366295 from a coarse, pebbly non-marine sandstone in the Eaglesnest Assemblage, Bowser Lake Group.

Experimental Methods:

Three oil stains found in Bowser Basin have been extracted, using the Soxhlet method and the extracts have been fractionated and analyzed following the description below (Osadetz and Snowdon, 1995). The $>210^{\circ}\text{C}$ gross compositions were determined using various fractions obtained from packed column elutions following techniques similar to those discussed by Snowdon (1978).

An aliquot of the fraction boiling above 210°C was deasphalted using an excess of pentane (40 volumes) and subsequently fractionated using open column liquid chromatography. Saturated hydrocarbon were analysed using gas chromatography (GC) and gas chromatography-mass spectrometry (GCMS). A Varian 3700 FID gas chromatograph, with 30 m DB-1 column and helium as the mobile phase, was used to obtain saturate fraction gas chromatograms (SFGC=s). The temperature was programmed from 50°C to 280°C at a rate of $4^{\circ}\text{C}/\text{min}$ and then held for 30 minutes at the final temperature. Successively eluting compounds were detected and quantitatively determined using a hydrogen flame ionization detector. Integration of the resulting gas chromatograms was done using *Turbochrom* ver. 6.1.1 software. Gasoline range parameters were calculated using measured and normalized percentage peak area while peak heights were used when processing saturate fraction gas chromatograms.

GCMS experiments were conducted using a VG 70SQ mass spectrometer with an HP 5890 gas chromatograph discharging directly to the ion source. A 30 m DB-5MS fused silica column was employed for GC separation. The temperature, initially held at 100°C for 2 min, was programmed at $40^{\circ}\text{C}/\text{min}$ to 180°C and at $4^{\circ}\text{C}/\text{min}$ to 320°C , then held for 15 min at 320°C . The mass spectrometer was operated with a 70 eV ionization voltage, 300 mA filament emission current, and an interface temperature of 280°C . The instrument was operated in selected ion monitoring mode and controlled by an Alpha Workstation using *Opus* software. Terpene and sterane ratios were calculated from the resulting m/z 191, m/z 217 and m/z 218 mass fragmentograms.

The aromatic fraction was analyzed on an HP 5973 mass spectrometer (30 m DB-5MS fused silica column) coupled with an HP 6890 gas chromatograph (injector at 250°C , split ratio 10:1, 1.2 ml/min flow and average velocity 40 cm/s). The oven temperature was programmed from the initial 100°C (no hold) to 300°C at a rate of $3^{\circ}\text{C}/\text{min}$ and then held for 10 min at the final temperature. The resulting mass fragmentograms were quantitated using ChemStation ver. B01.

Last updated March 14, 2003