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Savage et al.

Supplementary Methods

Rock samples were broken into 5-10 mm pieces using a rock hammer and chisel and rinsed by soaking in dichloromethane for ~20 minutes to remove any surfaced contamination. Following the dichloromethane rinse, all sample handling was with solvent rinsed tools and glassware that was combusted at 450 $^{\circ}$ C.

Rinsed samples were crushed in an alumina shatterbox to a fine powder. The shatterbox was cleaned between samples by crushing quartz sand (previously ashed at 450°C), followed by rinsing with de-ionized water, methanol and dichloromethane. Biomarkers were extracted from powdered samples by sonicating three times with dicholoromethane. The dicholormethane extract was transferred to 60 ml vials, a recovery standard added (5 α -androstane and 1,1'-binaphthyl) and evaporated to ~1-2 ml with nitrogen gas in a Turbovap. The extract was transferred to a 4 ml vial and the dichloromethane was replaced with hexane by adding hexane and evaporating the extract under a gentle stream of nitrogen to ~200 ul (repeated 3x). Blanks on shatterbox and extractions showed no detectable alkanes or diamondoids.

Aliphatic compounds were isolated from the total extract by silica gel column chromatography. Silica gel columns were prepared in Pasteur pipettes with 0.5 g pre-extracted silica gel and stored at 125 °C until use. The column was rinsed with three bed-volumes of hexane and the total extract in 200 μ l of hexane was pipetted onto the column. The aliphatic fraction containing *n*-alkanes and diamondoids was eluted with 1.5 ml of hexane. Throughout extraction, purification and analysis, samples were never allowed to evaporate to dryness to ensure quantitative recovery of volatile *n*-alkanes and diamondoids. Quantitative recovery was demonstrated with standards and samples analyzed before and after solvent replacement and purification.

The aliphatic fraction containing diamondoids was analyzed by gas chromatography (GC) with both flame ionization (FID) and mass selective detection (MSD). Diamondoids were identified based upon comparison with published mass spectra [Wingert, 1992], relative elution order [Fang et al, 2012], retention time relative to *n*-alkanes [Wingert, 1992] and comparison of spectra and retention times with authentic diamantane and 1-methyldiamantane standards. Diamondoids and *n*-alkanes were quantified with selective ion monitoring (m/z 57 for alkanes and m/z 188 and 187 for diamantane and methyldiamantanes, respectively). Response factors for MS quantification were determined from authentic standards (C₈-C₄₀ *n*-alkanes purchased from Supelco Analytical, Bellefonte, PA, diamantane and 1-methyldiamantane purchased from Chiron AS, Norway).

Calculation of Latent Heat of Melting

The mineral assemblage of the Pasagshak cataclasite consists of ~ 45% albite, 15% quartz, and %40 phyllosilicates (mostly muscovite and chlorite). Given that ~90% of the BFRs are melt at their thinnest, we calculate the latent heat of fusion as:

 $H = 0.9(0.15H_{Q} + 0.45H_{A} + 0.4H_{M})$

where H_Q , H_A , and H_M are the latent heat value of quartz, albite and muscovite (O'Hara 2001). Muscovite was used to represent phyllosilicates.



Figure DR1. An example of a chromatogram from a sample run through a GC-MS and analyzed for diamantanes and *n*-alkanes.

| Sample Number | Distance from BFR | % [D + 4-MD + 1- MD + 3-MD]/[C10- 40alkanes] | Description |
|------------------|---|--|--|
| PP478, , | 0 | 21.04, | Sample has two ~2 mm-thick strands of BFR lying along the foliation which were subsampled. (BLKSTF of Rowe et al. 2011 Fig 1) |
| PP498 | 0.001 m | 14.47 | Sample taken directly next to the 2 mm thick pseudotachylyte vein in sample PP478 |
| PP499 | 0.02-0.05 m | 9.65 | Sample taken from ~2-5cm from the thin pseudotachylyte vein in sample PP478 |
| PP495 | 5-70 m | 6.83, 8.93 | Sample was not in situ; was found adjacent to cliff. Assuming it fell from that cliff, possible range ~5-70 m from pseudotachylyte-bearing surface. |
| PP497, | 0 m | 20.27 | ~12 cm-thick BFR with sandstone hanging wall and argillitic cataclasite in the footwall (WPT015E of Rowe et al. 2011 Fig 1) |
| PP566 | \sim 70 m ± 10 m (uncertainty estimate from along-strike projection of fault dip) | 4.23 | Estimated from hanging wall position structurally above nearest fault core outcrops (between BLKSTF and WPT009, Fig 1 of Rowe et al., 2011) |
| PP568 | \sim 225 m ± 25 m (uncertainty estimate from along-strike projection of fault dip) | 2.32 | Estimated from hanging wall position structurally above nearest fault core outcrops (NE of BLKSTF, Fig 1 of Rowe et al. 2011) |

Table DR1: Detailed Description of Samples

References

Fang, C., Xiong, Y., Liang, Q., Li, Y., 2012. Variation in abundance and distribution of diamondoids during oil cracking. Organic Geochemistry 47, 1-8.

O'Hara, K., 2001, A pseudotachylyte geothermometer: Journal of Structural Geology, v.23, p.1345-1357.

Wingert, W.S., 1992. G.c.-m.s. analysis of diamondoid hydrocarbons in Smackover petroleums. Fuel 71, 37.