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# Letter to the Editor: SOURCE OF POLYNUCLEAR AROMATIC HYDROCARBONS IN PRINCE WILLIAM SOUND, ALASKA, USA, SUBTIDAL SEDIMENTS

Jeffrey W. Short
*NOAA*

Ron A. Heintz
*NOAA*

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*Letter to the Editor*

# SOURCE OF POLYNUCLEAR AROMATIC HYDROCARBONS IN PRINCE WILLIAM SOUND, ALASKA, USA, SUBTIDAL SEDIMENTS

To the Editor:

Recently Page and coworkers [1] concluded that polynuclear aromatic hydrocarbons (PAHs) detected in the deeper subtidal sediments of Prince William Sound, Alaska, USA, derive from oil seeps in the northern Gulf of Alaska. Coal was erroneously dismissed as an alternative source of these PAHs, based on the claimed absence of reported coal deposits east of the Bering River coal field. The reference given to support this claim is apparently a geological map of western Prince William Sound [2]. This map is irrelevant. In fact, a substantial coal field lies east of the Bering River field in the Robinson Mountains near Cape Yakataga [3].

Coal-bearing geologic formations related to those containing the Bering River and Robinson Mountains coal fields extend further eastward to Tyndall Glacier in Icy Bay [4], where coworkers at our laboratory have found coal on beaches. These coal-bearing formations are extensive and are currently subject to glacial erosion. Glacial flour produced by this erosion may contain fine-grained coal particles that could be readily transported into the Gulf of Alaska and then to Prince William Sound following introduction into the Alaska Coastal Current. Thus, the source of the PAHs found in the marine sediments of the northern Gulf of Alaska may be coal instead of oil seeps, and a definitive resolution of these alternatives remains to be established. Page and coworkers should therefore have acknowledged that coal remains a plausible alternative PAH source and omitted the word ''petroleum'' from the title of their report [1].

Jeffrey W. Short
Ron A. Heintz
Auke Bay Laboratory
National Marine Fisheries Service, NOAA
Juneau, Alaska, USA

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The authors' reply:

We thank Short and Heintz for their comments on our paper [1]. The source of the substantial natural petrogenic hydrocarbon background found in Prince William Sound clearly is not *Exxon Valdez* oil. We disagree with Short and Heintz that coal is a plausible alternative PAH source for the regional petrogenic hydrocarbon background identified in Prince William Sound benthic sediments and elsewhere [1]. Short and Heintz correctly identify a small coalfield in the Robinson Mountains identified in Alaska coal maps previously unavailable to us [2] and therefore not cited in our paper. We have since spoken with the author of the conference proceeding report cited by Short and Heintz [3] and are satisfied that some sort of coal deposits do exist in the Robinson Mountains 150 miles east of Prince William Sound. However, we do feel there is no geochemical evidence that extractable hydrocarbons from coal contribute to the regional petrogenic hydrocarbon background we report. We rely on chemical data reported by us in this *ET&C* paper, on data reported in a 1996 publication by Bence et al. [4], and on the results of chemical analyses of environmental samples collected by Short and Heintz from the areas in question as reported by Carlson et al. [5]. These are the samples Short and Heintz refer to in their letter.

The Bering River coalfields east of Prince William Sound cannot be the dominant source of this hydrocarbon background, based on saturate biomarker ratios reported in Carlson et al. [5] for National Oceanic and Atmospheric Administration (NOAA) coal and sediment samples obtained from Short and U.S. Geological Survey (USGS) benthic sediments from Prince William Sound and the Gulf of Alaska (Fig. 1). Benthic sediment saturate biomarker ratios more closely match those of the Yakataga seep oil than either Bering River area coal or Katalla seep oil. The ratio Ts/(Ts + Tm) plotted in Figure 1 is calculated from the ratios of the Trisnorhopanes Ts(18$\alpha$(H)-22,29,30) and Tm(17$\alpha$(H)-22,29,30). Ts is thermally more stable than Tm, so the ratio Ts/(Ts + Tm) increases with maturity [6]. The similarity in ratios for both the Yakataga oil and the Prince William Sound benthic sediment hydrocarbons is consistent with their being less mature thermally than either Katalla seep oil or Bering River area coals. Similarly, we have found PAH isomer maturity indicators (not shown) to confirm that the PAH in benthic sediments are less thermally mature than Katalla oil, consistent with a source such as Yakataga.

It would not be surprising if the PAH and saturate biomarker distributions in area coals were similar to those of area oils since these oils were generated in sources dominated by terrigenous organic matter. In fact, the coals may be the source of the oils, as is true in a number of places around the world, such as the Gippsland Basin of Australia and the Mahakham Delta of Indonesia [7]. If so, the coals are expected to be somewhat to significantly more mature than the oils because the oils are generated and expelled from the coals at lower