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Evidence for petroleum systems offshore Baffin Island

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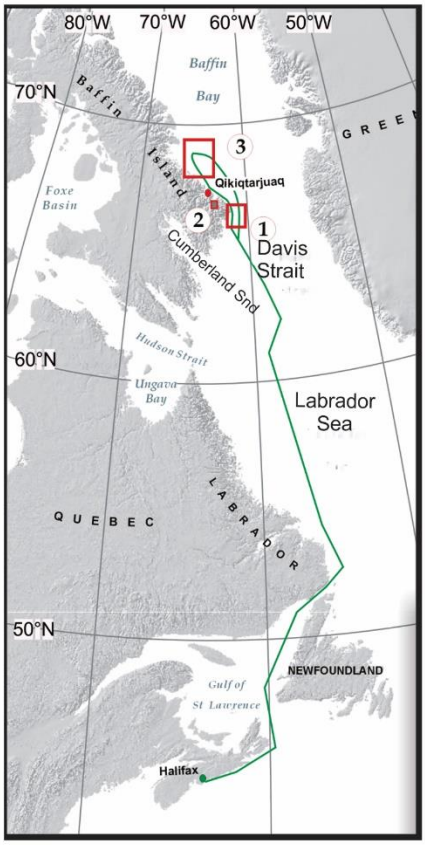
Summary

The long term study of offshore Baffin Island demonstrates that several of the many persistently observed satellite synthetic aperture radar (SAR) imaged “dark targets” on the ocean surface are bona fide oil slicks resulting from natural petroleum seepages at the seafloor. This offshore region of the eastern Canadian Arctic has been investigated for the presence of petroleum sporadically over the last forty years, starting with studies of visible oil seepage at sea off Scott Inlet, Baffin Island (Loncarevic and Falconer, 1977). Subsequent research has found hydrocarbons in shallow sea floor rock drill cores from the Davis Strait area off Cumberland Sound (MacLean and Srivastava, 1981) and identified seafloor gas pockmarks off Cape Chidley on seismic data (Fader, 1991). Use of satellite SAR data sets compared to seismic and gravity compilations showed a number of interesting correlations between dark targets and sub seafloor geophysical interpretations (Jauer and Budkewitsch, 2010) that went unproven until 2016 when the SAR anomalies mapped off Cape Chidley were confirmed as an oil slick occurrence (Fustic et al., 2017).

The 2018 study presented here targets two sites off Cape Dyer, Baffin Island (Figure 1) in an effort to identify and characterise the physical aspects of subsea petroleum seeps by water and surficial sediment sampling. This region was selected due to the numerous dark targets present and nearness to a zone of anomalously high amounts of dissolved methane in sea water near the seafloor measured by a chemical oceanographic profile that traversed the mapped SAR dark targets (Punshon et al., 2014) shown in Figure 2.

As the SAR data used was not recently acquired, the question of precisely locating active hydrocarbon seepage was attempted by visually spotting from an unmanned aerial vehicle (UAV) or by images from high resolution multibeam bathymetry and by digital photographic camera survey of the seafloor that might show the presence of pockmark features. Due to a legal moratorium there are no sources of other geophysical data more recently acquired than the early 1980’s.



Route of CCGS Hudson Arctic cruise 2018

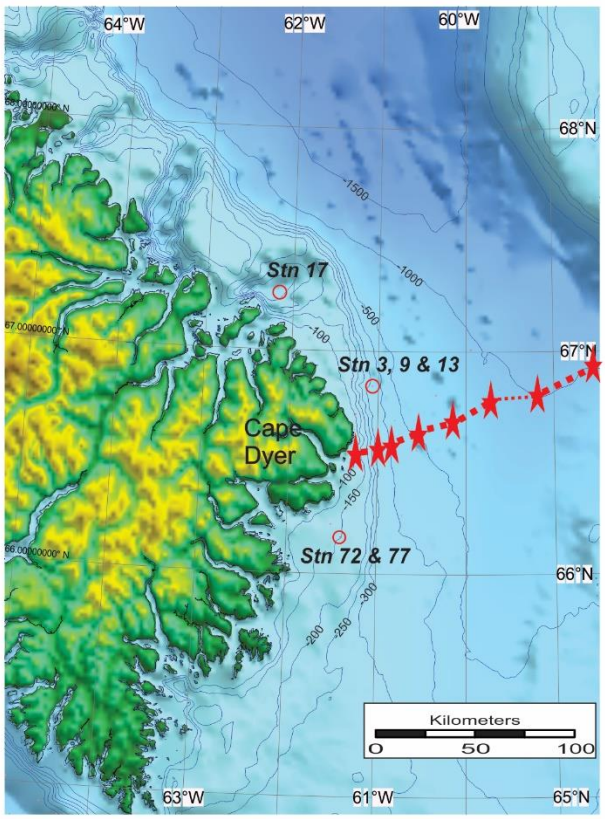
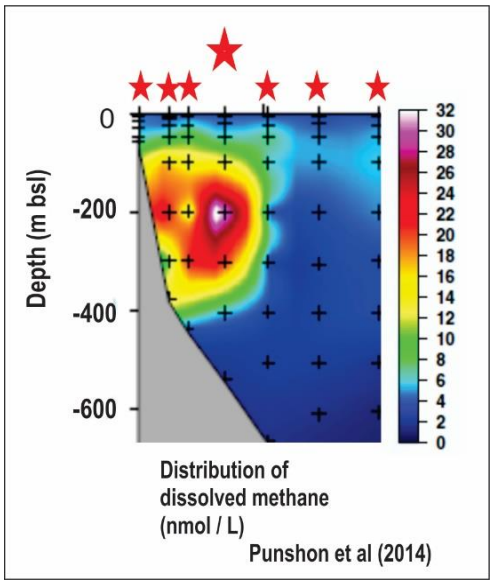


Figure 1



Data from the oceanographic traverse showing dissolved methane concentration with depth. Our investigation area at stations 3, 9 and 13, is about 28 km north east of the highest methane measurement point previously known. The station 17 location was taken to provide a background data set for an area that appears devoid of any SAR dark targets. The southern site, marked as stations 72 and 77 is located in an area of clustered dark targets.

Figure 2

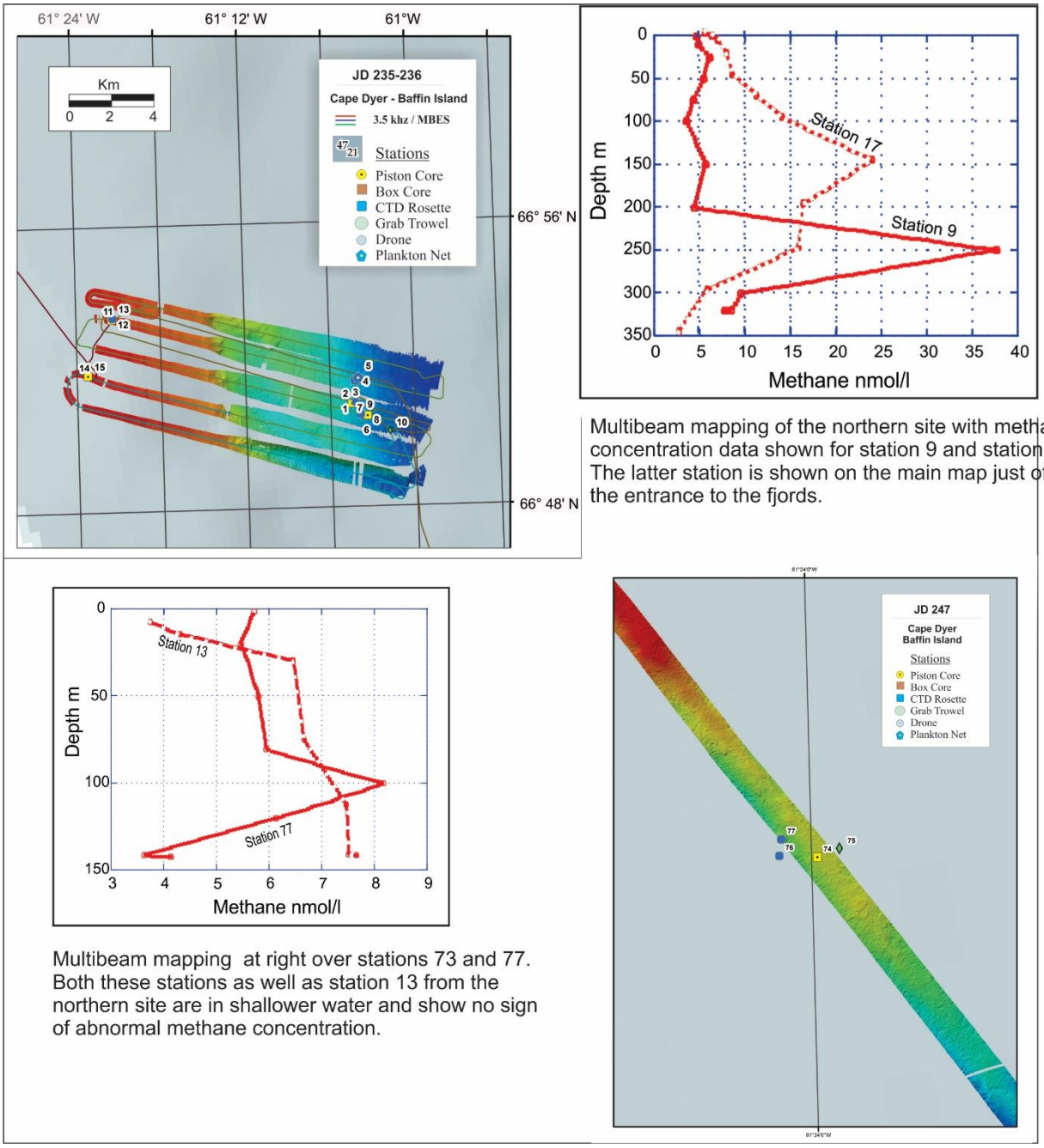


Figure 3

Methods

A CTD rosette water sampler made water conductivity and temperature measurements at five stations that was supplemented by digital camera drift surveys for seafloor biota and grab sampling of surficial sediments. A visual sweep of the sea surface for spotting oil slicks was attempted using an UAV, as the height of the camera offered a wider scan of the sea surface than visible from the ship's bridge.

Results

The multibeam did not show any definitive features such as a bioherm but several pockmark like features were present and became focal points for sampling. The methane values in seawater indicated the close proximity to a hydrocarbon seepage source or sources, however visual confirmation did not occur. Sediment samples from 5 stations are currently being studied by genomic sequence analysis to determine the presence of methanotrophic microbes and a geochemical analysis is planned. A biological assessment of imaged seafloor biota is in progress.

Conclusions

This region likely contains multiple seafloor hydrocarbon seeps that will require future investigation. The geological analysis indicates that this is likely an unconventional petroleum system, due to the influences of rift tectonics and volcanic intrusions in these relatively shallow sedimentary basins (Jauer et al.,2019).

Acknowledgements

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References

Fader, G.B.J., 1991 Gas related sedimentary features from the eastern Canadian continental shelf, Continental Shelf Research, Vol. 11, Nos. 8-10, p. 1123-1153

Fustic, M., Neves, B., Dove, R., Mort, A., Fowler, M., Chakraborty, A., Ellefson, E., Herder, E., Wareham, V., Dufour, S. and Edinger, E., 2017. Saglek Basin Macro-and Micro-Hydrocarbon Seeps– New Evidence, Reinterpretation, and Emerging Exploration Tools, (abs). Joint annual CSPG-CSEG CWLS GeoConvention, Calgary, Canada, May 2017, p. 5.

Jauer, C.D. and Budkewitsch, P., 2010. Old marine seismic and new satellite radar data: Petroleum exploration of north west Labrador Sea, Canada, Marine and Petroleum Geology, Vol. 27, Issue 7, p. 1379-1394, ISSN 0264-8172, DOI: 10.1016/j.marpetgeo.2010.03.003.

Jauer, C.D., Oakey, G.N., Li, Q., 2019 Western Davis Strait, a volcanic transform margin withpetroliferous features Marine and Petroleum Geology, in press.

Loncarevic, B. D. and Falconer, R K. 1977. An Oil Slick Occurrence Off Baffin Island, Report of Activities Part A. Geological Survey of Canada, Paper no. 77-1A, p. 523 524 https://doi.org/10.4095/102743

MacLean, B. and Srivastava, S.P. 1981. Petroliferous core from a diapir east of Cumberland Sound, Baffin Island, in Current Research Part A; Geological Survey of Canada, Paper 81-1A, pp. 399-400

Punshon S., Azetsu-Scott, K. and Lee, C.M. 2014. On the distribution of dissolved methane in Davis Strait, North Atlantic Ocean Marine Chemistry Vol 161, pp. 20-25