COMPARISON OF VERY LOW SULPHUR FUEL OIL WITH SPILLED OIL FOLLOWING GROUNDING OF MV WAKASHIO IN MAURITIUS, 2020

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Introduction

On the 25th July 2020, the bulk carrier MV Wakashio ran aground on a coral reef offshore of Pointe d’Esny, Southeast Mauritius releasing an estimated 1000 t of fuel oil into the Indian Ocean threatening internationally important wetlands.¹,² The MV Wakashio was reported³ to be carrying approximately 3,800 t of Very Low Sulphur Fuel Oil (VLSFO, defined as <0.5 % S⁴), 200 t of diesel oil, 100 t of lubricant oil and residual oil. In an attempt to reduce toxic emissions from the burning of heavy fuel oils containing high concentrations of S, ships are increasingly using VLSFO.⁴ Following the grounding of the Wakashio there has been much confusion about what was spilled and speculation in the media concerning conspiracies and cover-ups.

A sample of oil was collected from close to shore (20°23′49.7"S, 57°41′58.3"E) on 16th August 2020 by a volunteer worker and subsequently shipped to laboratories of the Western Australian Organic and Isotope Geochemistry Centre (WA-OIGC), Perth, Australia and Woods Hole Oceanographic Institution (WHOI), USA. A sample of Wakashio fuel oil was obtained from Sintef, Norway. The samples were analysed as whole oils diluted in dichloromethane by two-dimensional gas chromatography with Flame Ionisation Detection (GC×GC-FID) and with high resolution mass spectrometry (GC×GC-HRT) at WHOI. At WA-OIGC, the maltene fraction of the oils were separated by silica gel chromatography into saturate (100% hexane), aromatic (7:3 hexane: dichloromethane), polar (1:1 MeCl₂:methanol) and highly polar (100% methanol) fractions following precipitation of asphaltenes by repeated addition of chilled n-heptane and centrifugation. Fractions were analysed by gas chromatography mass spectrometry (GC-MS). In addition, the oils were subject to compound specific isotope analysis (CSIA) by gas chromatography isotope-ratio mass spectrometry (GC-irMS) to compare δ¹³C and δ²H of n-alkanes and isoprenoids. Elemental analysis was performed by inductively coupled plasma-mass spectrometry (ICP-MS).

Results

A full characterisation of the organic components of the oil collected in Mauritius by GC-MS and GC×GC-HRT revealed it to be unlike any previously seen spilled oil. The aromatic fraction was in particularly low abundance. Sulphur-containing heterocyclics were also in very low abundance. Suites of steranes and diasteranes were identified by GC×GC-HRT but were in low quantities. Triterpanes and hopane biomarkers, including seco-hopanes, helped to establish a profile of the oil that can be used for future fingerprinting of spilled oils. Additionally, a suite of C₁₅ and C₁₆ bicyclic sesquiterpanes were also present. Elemental analysis of the spilled oil showed that it contained only ~0.2% S which is well within the limit for VLSFO. Both vanadium and nickel were present in relatively low abundances. Stable isotopic analysis of the spilled oil revealed that δ¹³C values for isoprenoids were not significantly different to that of the corresponding n-alkanes. For δ²H however, there were a distinct offset with pristane and phytane showing more negative values.
A preliminary comparison by GC-MS of the spilled oil with the VLSFO used by the MV *Wakashio*, showed the former to have generally reduced abundances of saturated hydrocarbons with \(n\)-alkanes \(<n\text{-C}_{13}\) lost (Figure 1). Diagnostic ratios of the isoprenoids and \(n\)-alkanes were very similar (Figure 1). Biomarker profiles were also similar in the two oils. Comparing the suite of \(\text{C}_{15}\) and \(\text{C}_{16}\) bicyclic sesquiterpanes, some differences consistent with evaporation were observed of the lower molecular weight compounds.

![Figure 1](image)

**Figure 1** Comparison of the saturate fractions of oil sampled from nearshore Mauritius three weeks after grounding of the MV *Wakashio* (top) and Very Low Sulphur Fuel Oil used by the vessel (bottom). Inset shows \(n\)-alkanes and isoprenoids pristane (Pr), phytane (Ph) with corresponding ratios.

Characterisation of the spilled oil showed it to be consistent with VLSFO. A preliminary comparison with the VLSFO used by the MV *Wakashio* confirmed that the oils were similar despite the effects of weathering on the spilled oil. All evidence to data points to the grounding of the MV *Wakashio* in July 2020 to be the first spill of this class of fuel oil. Further on-going analyses will be used to more fully examine the oils.

**References**

1. Ramsar, Ramsar Sites Information Service. Available: [https://rsis.ramsar.org/ris-search/?f%5B0%5D=regionCountry_en_ss%3AAfrica&f%5B1%5D=regionCountry_en_ss%3AMauritius&pagetab=1](https://rsis.ramsar.org/ris-search/?f%5B0%5D=regionCountry_en_ss%3AAfrica&f%5B1%5D=regionCountry_en_ss%3AMauritius&pagetab=1). Accessed 24.11.2020.