Lithology, Physical Properties, and Oil Signs in Core Samples From Sagara Oil Field: Sagara Drilling Program (SDP)

Satoshi Hirano[1], Yoshiaki Araki[2], Hideki Wada[3], Sagara Drilling Program Scientific Party

[1] IFREE, JAMSTEC, [2] Geosciences, Osaka City Univ, [3] Faculty of Science, Shizuoka Univ.

http://www.jamstec.go.jp/jamstec-j/IFREE/ifree4/ifree4_j.html

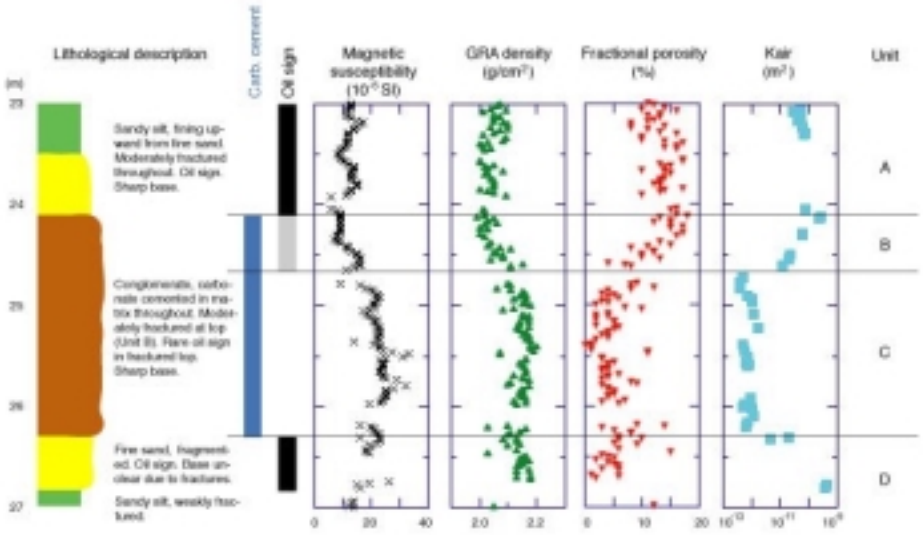
Sagara oil field, located in the central Honshu Arc, is unique from geological, geophysical and geochemical viewpoints: This is the only oil field in forearc regions, that faces the Pacific side of the Japan Arc. In the forearc basins on the Nankai accretionary prism, presently developing just to the south of the Sagara field, contains significant concentrations of methane hydrate. It is expected that production of hydrocarbons and oil within these two fields is closely related. Therefore, study on oil formation and subsequent migration processes in the Sagara field are expected to a produce a fundamental information for geochemical circulation of organic matters in the forearc regions. In this report, we will discuss relationships among lithology and physical properties for the recovered cores.

Based on visual core descriptions, recovered core was composed of alternation of siltstone, sandstone and conglomerates. We correlated recovered interval to the Tokigaya Formation, lowermost part of Sagara Group.

We performed non-destructive physical-property measurements to clarify the relationships among lithology, physical property, and existence/absence of oil stains. The measurements include magnetic susceptibility and Gamma Ray Attenuation (GRA) bulk density by Multi-Sensor Core Logger (MSCL) at JAMSTEC, gas permeability by Pressure Decay Profile Permeameter (PDPK) at the Japan National Oil Corporation, pore-size distribution by Mercury-injection method at Shimadzu Corporation, and grain-size distribution by Laser Diffraction particle Size Analyzer in Osaka City University.

The typical variations in physical properties in the recovered core correlate well with the lithology within the depth from 23.00 to 27.00 m. In this interval, we divided into four units, A (23.00 to 24.10 m), B (24.10 to 24.60 m), C (24.60 to 26.35 m), and D (26.35 to 27.00 m), in the decending order, based on the occurrence of oil stain and variation in physical properties of rocks. Oil stains are clear in two Units, A and D, while no oil stains occur in Unit C. Unit B is gradational zone between the Units A and C. Rare oil stains are recognized in the Unit B. Unit D composed of fine sand and sandy silt, both of which are fragmented or weakly fractured throughout this interval. This Unit was characterized by high permeability and GRA density, relatively low and fluctuated porosity, and moderate values of magnetic susceptibility comparing with other Units. In particular, the permeability rapidly decreased at the top of this Unit. These features may cause overpressure condition of interstitial fluid, including oil stains in this part. Unit A consisted of fine sand, which is gradually fining upward to sandy silt at top. This unit was characterized by high porosity and permeability. These features suggest that there is a capacity of oil reservoir within this interval. Unit C composed of conglomerate with carbonate cemented in matrix. No oil stains occurred in this Unit. This Unit was characterized by the low porosity and permeability. The absence of oil stain in this Unit is obviously reflected to the low porosity and permeability. This suggests that the carbonate-cemented conglomerate plays an important role of the 'cap rock' for the oil stain in underlying Unit D. Unit B was equivalent to a top part of the same layer of the Unit C, characterized by moderate development of fractures. The physical properties gradually changed with depth, therefore, this Unit is a gradational zone from the impermeable Unit C to the permeable Unit A to migrate oil upward. The development of fracture may play a role of oil migration through this Unit.

The preliminary results obtained general information of recovered core and typical relationship among lithology, physical properties, and oil stains. The results showed small-scale migration process of organic material, but it has basic information to understand geochemical cycle in the forearc basins.


Lithological description
Carb. cement
Oil sign
Magnetic susceptibility (10^{-5} SI)
GRA density (g/cm^3)
Fractional porosity (%)
Kair (m^2)
Unit
[m]
23
24
25
26
27
Sandy silt, fining upward from fine sand. Moderately fractured throughout. Oil sign. Sharp base.
Conglomerate, carbonate cemented in matrix throughout. Moderately fractured at top (Unit B). Rare oil sign in fractured top. Sharp base.
Fine sand, fragmented. Oil sign. Base unclear due to fractures.
Sandy silt, weakly fractured.
A
B
C
D
0
20
40
2.0
2.2
0
10
20
10^{-13}
10^{-11}
10^{-9}