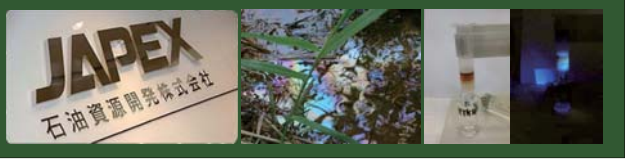
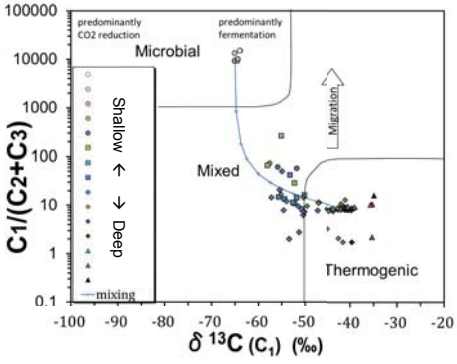
Geochemical Analysis of Petroleum -- Reducing Exploration Risk



Summary

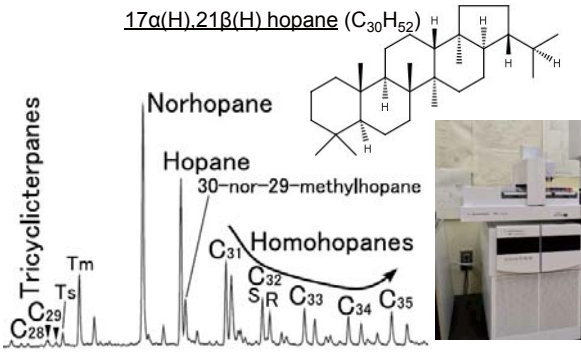
Geochemical analyses of petroleum hydrocarbon (crude oil and gas) are conducted to reduce various risks associated with the exploration, development and production stages of oil/gas fields. Using geochemical data, such as the molecular and isotopic composition data of gases and the biomarker compositions of oils, we can evaluate paleoenvironments, the ages and maturity of hydrocarbons, reservoir continuity, migration and accumulation processes, etc. to enhance petroleum discovery rates and improve the efficiency of reservoir development plans.

Composition and Isotope Analysis of Gas



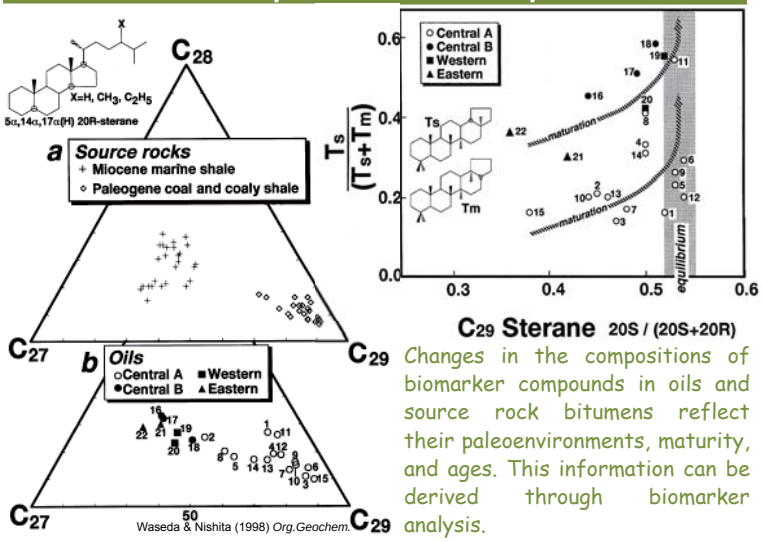
Hydrocarbon gases are either derived from the metabolism of micro-organisms (microbial/biogenic origin) or generated thermally from the source rock (thermogenic origin). These origins are distinguishable through analysis of chemical compositions and isotopic ratios.

Biomarker Analysis of Oil with GC-MS



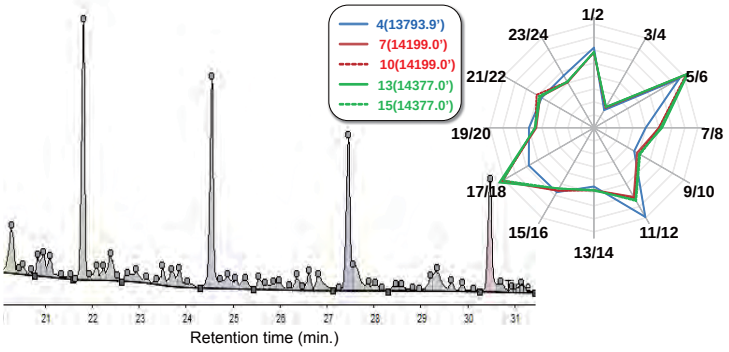
To separate and identify various compounds, such as biomarkers in crude oils, gas chromatography-mass spectrometry (GC-MS) is used. Various compounds are separated by GC based on differences in their boiling points and then identified according to the mass spectra specific to individual compounds using MS.

Biomarker Interpretation for Exploration



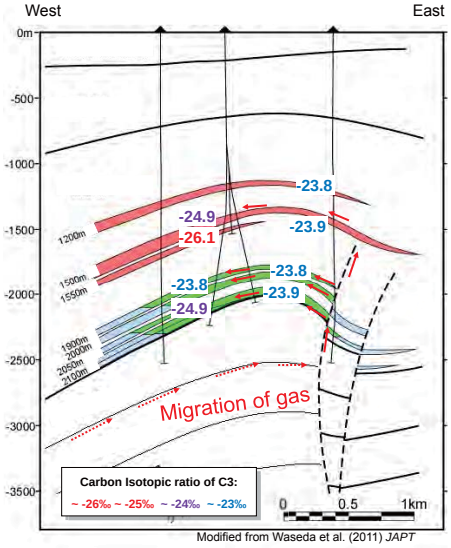
Changes in the compositions of biomarker compounds in oils and source rock bitumens reflect their paleoenvironments, maturity, and ages. This information can be derived through biomarker analysis.

Reservoir Geochemistry (Fingerprint Analysis)



Chemical compositions of crude oils differ slightly between each reservoir, even if the source of two reservoirs is the same. These slight differences can be evaluated through fingerprint analysis using GC chromatograms. Fingerprint analyses are applied in reservoir continuity and connectivity studies as well as production allocation studies of different reservoirs.

Migration and Accumulation of Oil and Gas



Migration and accumulation processes can be estimated using isotope analysis.
The left figure shows that the gases generated in a source rock have moved east and upward along a fault because of their buoyancy, and were supplied from east to west in the reservoir formation.
Such studies can reduce migration risks in further exploration and development stages and enhance discovery rates.

Key Points

Geochemical analyses of petroleum through GC, GC-MS, and isotopic ratio-MS are used in various evaluation studies as described below:

(1) Exploration geochemistry — Clarification of the petroleum system of a target basin through oil-source rock correlation and evaluation of migration and accumulation using biomarker and isotope ratio analyses.
(2) Reservoir geochemistry — Evaluation of reservoir continuity and production allocation through correlation of different reservoirs using biomarker, fingerprint, and isotope ratio analyses.

These analyses contribute to enhancing the success rates of exploration and improve the efficiency of reservoir development planning. Geochemical analysis therefore contributes to risk reduction at all stages of petroleum exploration and production.