coastal water well. Geochemical analyses indicate the presence of 74 to 91% methane, 7 to 23% nitrogen, ~2% carbon to dioxide, and <1% ethane. The gas appears to be thermogenic in origin as it has $\delta^{13}C$ values of −29.51 to −32.5 ‰ PDB. Oil-saturated sandstones have also been dredged from a depth of 700 m (2,300 ft) in Ascension submarine canyon, further indicating the natural seepage of hydrocarbons in this area. We interpret these natural hydrocarbon seeps to be the result of migration from depth along active faults within the San Gregorio and Monterey Bay fault zones.

High-frequency, high-resolution seismic reflection surveys in unexplored offshore areas may yield evidence for hydrocarbons that are not detectable with conventional, deep-penetrating, low-frequency (<100 Hz) seismic reflection systems, and thus may be very valuable in the search for oil and gas accumulations.

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Tectonic and Paleobiologic Significance of Permian Radiolarian Distribution in Circum-Pacific Region

The Cordillera of North American is a mosaic of allochthonous fault-founded terranes, many of which contain abundant radiolarian chert of Permian age. Permian paleolatitudes for some terranes can be reconstructed by using fusilinid, megafossil, and paleomagnetic data. Cosmopolitan Wolfcampian and older radiolarian faunas extend north as far as the Brooks Range of northern Alaska. By late Wolfcampian or early Leonardian time (*Pseudoalbaillella scalprata* Assemblage), a marked diversity gradient developed between tropical high diversity faunas and temperate low diversity faunas. Albaillellaria became restricted to terranes with low paleolatitudes, but radially symmetrical cross-axon radiolarians still extended into temperate paleolatitudes. The Brooks Range, Innoko, Angayucham, and Red Paint terranes of northern and central Alaska all contain low-diversity late Wolfcampian and/or Leonardian faunas. Megafossil data indicate that these terranes may not be enormously displaced. In contrast, the Wrangellia terrane of southern Alaska, which is greatly displaced from low paleolatitudes, contains very diverse tropical Leonardian faunas. Similar faunas occur in the Golconda allochthon of Nevada and are reported from the tropical Bone Spring Limestone (Leonardian) of Texas. By Guadalupian time (*Follicucullus scholasticus* Assemblage), all distinctive radiolarian lineages were apparently restricted to tropical or subtropical extinctions which first affected temperate faunas during late Wolfcampian or Leonardian time, then affected subtropical or tropical faunas by late Guadalupian or post-Guadalupian time, and culminated in worldwide extinctions in latest Permian or earliest Triassic time. As the transgressive extinctions moved from temperate to tropical paleolatitudes, diverse faunas were replaced by very low-diversity entactiniid faunas and/or nondeposition. The gradual restriction of Permian radiolarian faunas records increasingly unfavorable oceanic conditions that eventually resulted in the worldwide extinction of all but the most adaptable radiolarians.

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Pennsylvanian and Permian Radiolarian Assemblages in Cordillera of North America

Pennsylvanian and Permian radiolarians are common constituents of the allochthonous siliceous rocks of the Cordillera of North America. Eight widely distributed Pennsylvanian and Permian radiolarian assemblages are defined for this region. These assemblages are dated by (1) joint occurrence with conodonts, as well as by (2) correlation with dated radiolarian-bearing sequences on the craton of North America. From oldest to youngest, these assemblages are:

(1) *Pseudoalbaillella* sp. A Assemblage.—In Nevada this assemblage occurs with Desmoinesian conodonts. It correlates with Desmoinesian radiolarian faunas from Oklahoma.

(2) *Ps. U-forma–Ps. elegans* Assemblage.—This assemblage occurs with late Wolfcampian conodonts in Alaska. It apparently correlates directly with the Japanese assemblage of the same name.

(3) *Ps.* sp. B–*Ps. elegans* Assemblage.—The biostratigraphic position of this assemblage is uncertain. It predates *Ps. scalprata* Assemblage and probably postdates *Ps. U-forma–Ps. elegans* Assemblage in the Cordillera. This assemblage cannot be correlated directly with known North American cratonal faunas or with Japanese assemblages.

(4) *Ps. scalprata* Assemblage.—This assemblage occurs with Leonardian conodonts in Nevada and Alaska. It may be equivalent to the Japanese assemblages *Ps. lomentaria* and/or *Ps. rhombothoracata*. The latter occurs with late Wolfcampian conodonts.

(5) *Ps.* sp. aff. *Ps. rhombothoracata–Ps.* sp. aff. *Ps. sakmaraensis*.—This assemblage is not independently dated in the Cordillera; it appears, however, to grade into *Follicucullus scholasticus* Assemblage. It may be correlative with the *Ps. rhombothoracata* Assemblage in Japan and with the Leonardian Bone Spring Limestone of Texas.

(6) *Ps. fusiformis* Group Assemblage.—This assemblage is younger than or equivalent to the Cordilleran *Ps.* sp. aff. *Ps. rhombothoracata–Ps.* sp. aff. *Ps. sakmaraensis* Assemblage. The lower part of the assemblage zone correlates well with the Leonardian Bone Springs Limestone. The most closely related Japanese assemblage is *Ps. globosa* Assemblage.

(7) *Follicucullus scholasticus* Assemblage.—This assemblage occurs with Wordian(?) conodonts in northern California. It is apparently correlative with the Guadalupian Lamar Limestone of Texas and with the Japanese assemblages *Fo. moancanthus*(?) and *Fo. scholasticus*.

(8) *Neoalbaillella* Assemblage.—This assemblage correlates with either *Na. optima* and/or *Na. ornithoformis* Assemblages in Japan. Elements of this assemblage overlie Wordian brachiopods and underlie Middle Triassic ammonites in Nevada. The assemblage is not known to occur on the craton of North America.

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Control of Terrigenous-Carbonate Facies Transitions by Baroclinic Coastal Currents

The cross-shelf movement of fine-grained terrigenous sediment has received considerable attention in recent geological literature. Of perhaps greater interest is the spatial relationship with other sediment types and the processes that control facies segregation. Studies of sediment distribution on the shallow and broad shelf off the east coast of Nicaragua have revealed a 20 to 30 km (12 to 19 mi) wide band of terrigenous sediment confined near the coast. The band grades abruptly into an area of carbonate deposition that is composed principally of the disintegration products of calcareous green algae.

Detailed studies of watershed runoff, structure of nearshore