freshwater phreatic environment. This intepretation is consistent with the vadose origin ascribed to features observed within other parts of the complex.

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Deduction of Past Geothermal Gradients in Neogene Siliceous Rocks in Circum-Pacific Region

Zones of diagenetic silica record past geothermal gradients in Neogene diatomaceous sediments and siliceous rocks in the Circum-Pacific region and are useful in evaluating the petroleum potential of these important source rocks. In many areas burial diagenesis has produced the well-known lithologic and mineralogic progression: diatomite (opal-A) → chert and porcelanite (opal-CT) → chert and porcelanite (quartz). Temperature is an important control of these transformations. The range in temperature for the conversion of opal-A to opal-CT, calculated from measured values of heat flow and thermal conductivity, is 25 to 56°C. Opal-CT transforms to quartz in the range 43 to 81°C. Similar ranges of temperatures are calculated from oxygen isotopes of opal-CT and quartz from cherts and porcelanites using the experimental fractionation for quartz and water, assuming the transformations occurred in isotopic equilibrium with water whose oxygen isotopic composition differed only slightly from standard mean ocean water. Taking the top and base of the opal-CT zone as approximate isotherms, the past geothermal gradient for any area equals the difference between these isotherms divided by the thickness of the opal-CT zone. In addition, both the thickness and the depth (reconstructed maximum overburden) to the top of this zone decrease with increasing geothermal gradient. Because depth and thickness are related by a simple linear expression, either may be used to estimate past geothermal gradients in Neogene siliceous rocks.

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Important Stratigraphic Breaks in COST GE-1 Well, Southeast Georgia Embayment

A foraminiferal analysis of the recently completed Continental Offshore Stratigraphic Test (COST) GE-1 well reveals that ~1,000 m of Cenozoic, ~700 m of Upper Cretaceous, and ~1,600 m of Lower Cretaceous sedimentary rocks lie above Devonian metamorphic basement in this part of the Southeast Georgia embayment. Seven regional hiatuses interrupt the depositional record and correspond to times of low global sea level. The hiatuses are between Albian and Turonian rocks; upper Maestrichtian and upper Paleocene; upper Paleocene and lower Eocene; upper Eocene and lower Oligocene; middle Oligocene and middle Miocene; middle Miocene and upper Pliocene; and upper Pliocene and lower Pleistocene. The depositional environments represented in the GE-1 well range from terrestrial nonfossiliferous biotopes to ocean depths equivalent to those of a modern continental slope. Most of the Cenozoic and Upper Cretaceous rocks accumulated in continental-shelf biotopes, but the Lower Cretaceous rocks are largely nonmarine and marginal-marine deposits. The sequence of paleo-environments can be correlated with the supercycles of global sea-level change outlined by P. Vail et al. Sediment-accumulation rates were highest (5.0 to 6.4 cm/1,000 years) during the Albian through Santonian interval, the middle and late Eocene, and the middle Miocene. Lowest rates (1.3 to 2.5 cm/1,000 years) prevailed during the Campanian and Maestrichtian, the early and middle Oligocene, and the Pleistocene. Subsidence calculations reveal that Cretaceous subsidence was more rapid than that of the Cenozoic, that most of the major paleobathymetric changes were caused by eustatic sea-level fluctuations, and that subsidence rate of the embayment was sensitive to sediment loading and unloading.

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Temporal and Spatial Distribution of Ice-Rafted Mineral Grains in Pliocene Sediments of North Atlantic

An important find of Deep Sea Drilling Project (DSDP) Leg 12 was ice-rafted mineral grains in Pliocene sediments of the Labrador Sea and the Hatton-Rockall Basin. The oldest (first) occurrence of ice-rafted mineral grains in these sediments is associated with the evolutionary first appearance of the planktonic foraminifer *Globorotalia inflata* (d'Orbigny) and the extinction of the coccolith *Reticulofenestra pseudoumbilica* Gartner. This association yields a paleontologic age estimate of 3.0 m.y.B.P. for the start of low-elevation Northern Hemisphere glaciation extensive enough to produce icebergs in the North Atlantic. Results from subsequent drilling in the North Atlantic (DSDP Legs 37, 48, and 49) confirm that the first occurrence of ice-rafted mineral grains in North Atlantic sediments is at about 3.0 m.y.B.P. and further show that, during the Pliocene, icebergs penetrated as far south as 45°N lat. (DSDP hole 410) but not as far south as 37°N lat. (DSDP holes 333 and 335).

The estimated age of 3.0 m.y.B.P. for the onset of Northern Hemisphere low-elevation glaciation derived from the North Atlantic is compatible with, although slightly younger than, the 3.2 m.y.B.P. estimate suggested by paleomagnetically controlled isotopic data from the Equatorial Pacific.

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Diagenesis in Hygiene and Terry Sandstones (Upper Cretaceous), Spindle Field, Colorado

Recent research in the field of sandstone diagenesis suggests a relation between depositional fabric and the observed pore-filling sequence. An ordered paragenetic sequence representing an ordered decrease in energy-of-formation ($\Delta G°_f$) values is reported for fine-grained, poorly sorted sandstones. Coarser grained, better sorted sandstones from the same depositional environment show unordered diagenesis with respect to $\Delta G°_f$, perhaps related to higher fluid flow and less influence of rock composition. A relation may also exist between diagenetic sequence and depositional environment;