OCEAN FLOOR METAMORPHISM AND DEFORMATION OF ROCKS FROM THE BASE OF THE GABBRO LAYER, TABLE MOUNTAIN, BAY OF ISLANDS OPHIOLITE, NEWFOUNDLAND

MOLL, Nancy E., Department of Geological Sciences, University of Washington, Seattle, Washington 98905

Many previous investigations of ophiolites have interpreted the structures and textures of the complex region at the base of the gabbro layer as being of igneous origin. The rocks at Table Mountain in the vicinity of the mafic-ultramafic contact have been syntectonically recrystallized at high temperatures. The gabbros are recrystallized to a fine-grained assemblage of plagioclase (plag), Al-rich clinopyroxene (cpx) and Mg-rich olivine. Large differences in the mg values of the mafic minerals, from rocks in close proximity, indicate that any original cumulus layers have been tectonically disrupted. Above the basal gabbros are gneissose rocks with large, strained cpx at the core of elongate lenses of small, unstrained, granular cpx. Commonly, brown hornblende (hbl) occurs interstitial to the fine-grained cpx. In a few areas, fine-grained amphibolite formed. The high TiO_2 content of the hbl (2.5 - 4.0 wt.%) indicates that it formed under high temperature conditions.

The rocks in the region of the mafic-ultramafic contact have been strongly folded, developing an axial plane foliation defined by tabular cpx and/or plag. Rod-like segregations of the two minerals form lineations that parallel the fold axes. Foliations in the contact zone are concordant with the fabrics in the underlying ultramafites. Christensen and Salisbury (1979) suggest that the mantle fabrics developed as the ophiolite moved away from a spreading center. It is concluded that the metamorphism and deformation of the lower crustal section was contemporaneous with the development of the mantle fabric.

GLACIAL MARINE SEDIMENTATION: DOES THE DEFINITION FIT THE DEPOSITS?

MOLNIA, B. F. and BINGHAM, M. P., U. S. Geological Survey, Menlo Park, CA 94025

The classic concept of glacial sedimentation in the marine environment most commonly recognizes only the presence of coarse-grained particles in a muddy matrix (a diamicton) as evidence for glaciation. Studies in Alaska adjacent to active glaciers or recently deglaciated areas suggest that this concept defines only a fraction of the total volume and types of glacial deposits in the marine environment. Consequently, the category of what geologists recognize as evidence of a previous glaciation is biased and incomplete. Today, almost one-third of the area draining into the northeastern Gulf of Alaska is glaciated and includes many tidewater glaciers actively generating icebergs. Non-tidewater glaciers discharge into the lakes or streams, which in turn transport sediment into the marine system. These streams have documented maximum suspended-sediment loads of greater than 3 g/L. The sediment distribution pattern in the offshore area is as follows. Adjacent to the tidewater glaciers are diverse areas characterized by diamicton, sand bodies, and lenses of fine sediment. Where the deposits are not massive, fine-grained thinly laminated sand and silt containing some ice-rafted debris are common. Many sedimentary units appear to have formed from density flows. Seaward from the glaciers, a progression of nearshore sand, grading into clayey silt or silty clay, is the rule. Ice-rafted pebbles are occasionally present in these units in minor amounts. Bottom currents may locally concentrate the coarser material into lag deposits. During periods of high iceberg production, pebble and introduction transportation increases, but only a reduction in the fine-grained sediment input leads to marine diamicton conditions.

SEA-FLOOR MOSAIC OF THE ALSEK RIVER POCKMARK, SLUMP, AND SEDIMENT-FAILURE AREA, NORTHEAST-GULF OF ALASKA

MOLNIA, B. F. and RAPPEPORT, M., U.S. Geological Survey, Menlo Park, CA 94025

We selected 20-km^2 area offshore from the Alsek River for a multi year study designed to document changes in an unstable sea-floor system. The area is characterized by gas-charged sediment, gas pockmarks and craters, and areas of intense sediment failure. A multi system survey of the 10-by-2-km area was made at a 100-m line spacing, utilizing miniranger navigation and 3.5- and 12-kHz, 400 to 800-J minisparker, and 5- to 25-in^3 air-gun acoustic systems. Additionally, we used a digital-recording and -processing side-scan sonar system with slant-range correction to compile a 100-percent-overlap sea-floor mosaic of the entire survey area. We collected sediment samples from within the area and uniboom seismic records between the area and the coastline. Our survey was conducted aboard the research vessel DISCOVERER during May and June 1980, and we anticipate that the area will be surveyed in 1981 and again in 1982. The study area consists of five zones: (1) a northwest zone of minimal disturbance, characterized by isolated pockmarks and a single slump; (2) a north-central zone of medium-density slumping; (3) a northeastern zone containing distinct slumps and pockmarks; (4) a central zone of intensive and massive disturbance, characterized by blocky failures, pockmarks, bottleneck depressions, and multiple scarps; and (5) a southern area of large slumps, debris accumulation, and possible scours. The gas saturation, high water content, and under-consolidation of the sediment are probably responsible for the intense active sediment failures taking place within the area.

DOKHAN FORMATION, EGYPTIAN EASTERN DESERT: TRANSITION FROM ISLAND ARC TO STABLE CONTINENTAL CRUST

MONRAD, J.R., Department of Geology, University of North Carolina, Chapel Hill, North Carolina 27514; and RESSETAR, R., Department of Earth Sciences, UNC-Wilmington, Wilmington, North Carolina 28403

The Dokhan Formation of the Egyptian Eastern Desert is a late Precambrian basaltic andesite to rhyolite suite. Chemical analyses of 65 samples indicate a roughly bimodal distribution (SiO_2 50-60% and > 70%) and calcalkaline to alkaline characteristics. Eruption of Dokhan lavas and minor ignimbrites postdated emplacement of syn- to post-kinematic calcalkaline intrusions associated with island arc formation (~850 m.y. ?). It preceded, and was possibly synchronous with, extension-related sedimentation of the Hammamat Formation. Dokhan volcanism predated intrusion of an LIL-enriched, CaO- and MgO-poor Younger Granite suite (607-580 m.y.) representing the final stage of continental crust development.

Chemical characteristics of the Dokhan suite are within the range of many continental margin suites (including Andean) except for high values of TiO_2 (up to 1.8% at 53% SiO_2) and Zr (166-863 ppm). The abundance of groundmass spinels, scarcity of hornblende phenocrysts, and constant Ti/V ratios indicate that the high Ti is related to the absence of hornblende as an important phase in differentiation of the suite. The Dokhan suite appears to represent the last phase of subduction-related volcanic activity and the initial stage of conversion of an island arc to a continental crust environment. The development of cratonic stability apparently related to the emplacement of the Younger Granites probably did not occur until after subduction had ceased.

TRONDHJEMITES AND RELATED ROCKS OF THE DHARWAR CRATON, INDIA

MONRAD, J. R., and FULLAGAR, P. D., Dept. of Geology, University of North Carolina, Chapel Hill, NC 27514, USA, HUSSAIN, S. M., and NAQVI, S. M., National Geophysical Research Institute, Hyderabad, India, and ROGERS, J. J. W., Dept. of Geology, University of North Carolina, Chapel Hill, NC 27514, USA

The Archean Dharwar craton of southern India contains a complex gneiss-migmatite terrane, greenschist belts of various ages, and younger plutonic rocks intruded post-tectonically. Granulite-facies rocks occur in the southern part of the craton, separated by an east-west transition zone from amphibolite-facies and lower-rank rocks to the north.

In the Hassan District of Karnataka, metamorphic grade is mostly amphibolite facies. Very old greenstone belts, such as Holenarasipur, are rich in ultramafic rocks but contain no clastic debris that could have been derived by erosion of a sialic "basement." The gneissic complex, although apparently younger than Holenarasipur and related belts, is also very ancient. Field relationships show that some parts of the gneiss-migmatite complex are older than the 3,360 m.y. age obtained for one of the gneissic units by Beckinsale and others (Nature, v. 283, p. 469, 1980).

Trondhjemite bodies have been intruded post-tectonically into the greenstone belts and gneisses. The bodies are massive, discordant, and lithologically uniform. A Rb-Sr whole-rock isochron for one of the bodies yields an age of 3,063 ± 39 m.y., with an initial ratio of 0.7013 ± 0.0002. Apparently, major compressive deformation has not occurred in the Hassan area after approximately 3,100 m.y. ago.

The initial Sr isotopic ratio of the trondhjemite is slightly higher than the value of 0.7000 to 0.7010 indicated by the growth curve obtained from trondhjemite and tonalite analyses by Peterman (in Barker, ed., Trondhjemites, dacites, and related rocks, Elsevier, p. 133, 1980). The Hassan trondhjemites, however, apparently represent sialic material extracted from the mantle and added to the crust.

TRONDHJEMITE FORMATION ALONG OCEANIC TRANSFORMS

MOODY, R.H.; IDLEMAN, B.D. and KIDD, W.S.F., Department of Geological Sciences, State University of New York at Albany, Albany, NY 12222

Although most rock types present in ophiolites are recovered routinely from oceanic transform faults, highly silicic phases, such as trondhjemite, are dredged relatively rarely. Two proposed paleotransform faults, the Coastal Complex in western Newfoundland, and the Arakapas fault in Cyprus, contain more abundant silicic rocks than ophiolites associated with them. Increased production of silicic rocks near transforms may result from two possible processes: 1) a primary process involving advanced fractionation at one ridge-transform intersection (RTI) resulting from magma isolation and/or contamination by volatiles, with subsequent passage of the resulting rocks through the active transform domain, and 2) a secondary process involving the creation of lithosphere at one RTI, horizontal and vertical motion of discrete slices of this lithosphere and enhanced deep-level hydration in the transform domain, and reheating of the deformed and metamorphosed lithosphere at the second RTI, producing minimum-melting trondhjemitic magmas from restricted lithologies such as amphibolites. The fact that silicic rocks are rare in dredge suites from transforms suggests that the first process may not be dominant, and perhaps indicates that large quantities of these rocks do not occur along transforms. The apparent paucity of silicic rocks may be explained by the second process, because rocks produced by it should occur only at relatively deep levels within the inactive fracture zone segments of transforms. As a result they may rarely be present for sampling at shallow levels. This hypothesis is supported by evidence from the Coastal Complex suggesting that partial melting of hydrated crustal rocks produced much of the trondhjemite present in that complex.

GEOLOGY AND OTHER DISCIPLINES: HISTORICAL PERSPECTIVES
GWCC, Room 206/207, 0800 hours

Robert H. Dott, Jr., Presiding

1 *Stephen A. Norwick*:* Geologic Image and Icon in the Works of Leonardo Da Vinci 0800
2 *R. M. Hazen,* M. H. Hazen:* Geology, Chemistry, and the Classification of Natural Productions 0830
3 *Sandra Herbert*:* Charles Darwin as a Young Geologist .. 0900
4 *William M. Jordan*:* Geology and Industry 0930
5 *George Rapp, Jr.*:* Sir Charles Lyell and the Origins of Archaeological Geology 1000
6 *Mott T. Greene*:* Border Wars: Geology and Physics in the Last One Hundred Years 1030
7 *Ursula B. Marvin*:* Crossing Intellectual Borders: Geology and Planetology 1100
8 *Henry Frankel*:* The Bearing of Paleontological Problems on the Continental Drift Debate 1130

PETROLOGY I: IGNEOUS
GWCC, Room 208/209, 0800 hours

John M. Sinton and J. Robert Butler, Presiding

1 *J. D. Sills,* D. Savage:* The Origin and Metamorphic History of Layered Ultramafic-Gabbro Bodies in Archaean High Grade Gneiss Terrains 0800
2 *James D. Hoover*:* A New Interpretation for the Early Crystallization History of the Skaergaard Intrusion 0815
3 *L. D. Raedeke,* I. S. McCallum:* Modal and Chemical Variations in the Ultramafic Zone of the Stillwater Complex 0845
4 *R. T. Helz*:* Experimental Verification of a Parent-Differentiate Relationship between Two Magmas: An Example 0900
5 *J. Stephen Huebner*:* Refinement of a Model for Basalt Crystallization 0915
6 *Robert F. Dymek*:* Petrogenetic Relationships between Andesine Anorthosite Dikes and Labradorite Anorthosite Wall Rock on Mont Du Lac Des Cygnes, St. Urbain Anorthosite Massif, Quebec 0930
7 *L. Peter Gromet,* Robert F. Dymek:* Evidence for at Least Two Geochemically Distinct Anorthosite Types in the St. Urbain Anorthosite Massif, Quebec 0945
8 *Robert T. Gregory,* Hugh P. Taylor, Jr., Robert G. Coleman:* The Origin of Plagiogranite by Partial Melting of Hydrothermally Altered Stoped Blocks at the Roof of a Cretaceous Midocean Ridge Magma Chamber, The Samail Ophiolite, Oman 1000
9 *R. H. Moody,* B. D. Idleman, W.S.F. Kidd:* Trondhjemite Formation along Oceanic Transforms ... 1015
10 *Daniel J. Fornari,* Alexander Malahoff, Robert W. Embley:* Andesites, Feti Basalts and other Cogenetic Submarine Volcanics from the Galapagos Rift 1030
11 *David M. Christie,* John M. Sinton:* Petrology of a Propagating Rift Tip on the Galapagos Spreading Center 1045
12 *Douglas S. Wilson,* Richard N. Hey, John M. Sinton, David M. Christie:* Magnetization Intensity and Iron Enrichment near the Eastern Galapagos High Amplitude Magnetics Boundary 1100
13 *John M. Sinton,* David M. Christie, Douglas S. Wilson, Richard Hey:* Petrological Implications of Propagating Rifts 1115
14 *Wilfred B. Bryan,* Geoffrey Thompson, John N. Ludden:* "Normal" Basalts from the Kane Fracture Zone and Adjacent Ridge Axes 1130
15 *J. R. Monrad, R. Ressetar*:* Dokhan Formation, Egyptian Eastern Desert: Transition from Island Arc to Stable Continental Crust 1145

MARINE GEOLOGY I: GENERAL
GWCC, Room 210, 0830 hours

P. J. Fischer and R. K. Matthews, Presiding

1 *Nicklas G. Pisias,* Margaret S. Leinen:* Geochemical Partitioning of Deep-Sea Sediments Using an Extended Version of Q-Mode Factor Analysis and Linear Programming 0830
2 *M. Leinen,* N. G. Pisias, J. Dymond, G. R. Heath:* Geochemical Partitioning: Application of an Objective Technique for End-Member Characterization 0845
3 *Paul A. Baker,* Miriam Kastner:* The Origin of Dolomite in Marine Sediments 0900
4 *Dean A. Dunn,* T. C. Moore, Jr., Lloyd D. Keigwin, Jr., Fay Woodruff:* An Apparent "Atlantic-Type" Carbonate Stratigraphy in the Late Miocene Equatorial Pacific Ocean 0915
5 *Thomas C. Johnson,* James E. Evans:* Organic Carbon Deposition and Diagenesis in Lake Superior 0930
6 *T. R. Janecek,* D. K. Rea, N. G. Pisias, M. Leinen:* Cenozoic Eolian Input to the Northeastern Pacific Ocean, Data from Core LL-44-GPC-3 0945
7 *Janet E. Moll,* Warren L. Prell, Margaret Leinen:* Fluctuations in Aridity and Trade Wind Intensity as Indicated by Eolian Material from Deep-Sea Cores off Northwestern Australia 1000

Coffee Break 1015

8 *Robert B. Dunbar,* Gerard M. Wellington, Peter W. Glynn, Ellen M. Druffel:* Stable Isotopes in a Branching Coral: A High Resolution Record of Seasonal Temperature Variations 1045
9 *John S. Killingley,* Richard F. Johnson, Wolfgang H. Berger:* Oxygen and Carbon Isotopes of Individual Shells of Planktonic Foraminifera from the Ontong-Java Plateau 1100
10 *R. K. Matthews,* R. Z. Poore:* The Tertiary $\delta^{18}O$ Record: Estimation of Amplitude of High Frequency Signal by Replicate Sampling 1115
11 *David P. Donegan,* Hans Schrader:* Laminated Hemipelagic Sediments of the Central Gulf of California: Biogenic and Abiogenic Components 1130
12 *P. R. Pinet,* Peter Popenoe:* Cenozoic Flow Patterns of the Gulf Stream over the Blake Plateau 1145

*Speaker

abstracts with programs

1980 ANNUAL MEETINGS
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with

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THE MINERALOGICAL SOCIETY OF AMERICA (61st)
THE SOCIETY OF ECONOMIC GEOLOGISTS (60th)
CUSHMAN FOUNDATION (31st)
GEOCHEMICAL SOCIETY (25th)
NATIONAL ASSOCIATION OF GEOLOGY TEACHERS (21st)
GEOSCIENCE INFORMATION SOCIETY (15th)

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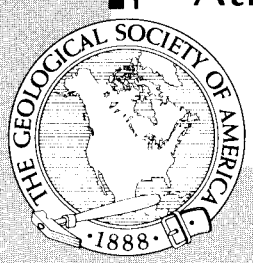

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