

Zeitschrift: Archives des sciences [1948-1980]
Herausgeber: Société de Physique et d'Histoire Naturelle de Genève
Band: 33 (1980)
Heft: 1-3

Artikel: Palaeogene komatiites from the ultramafic part of the Gorgona Ophiolites (Colombia)
Autor: Dietrich, V.J. / Gansser, A. / Cameron, W.E.
DOI: <https://doi.org/10.5169/seals-739500>

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. [Siehe Rechtliche Hinweise.](#)

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. [Voir Informations légales.](#)

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. [See Legal notice.](#)

Download PDF: 05.05.2025

ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>

PALAEOGENE KOMATIITES FROM THE ULTRAMAFIC PART OF THE GORGONA OPHIOLITES (COLOMBIA)

BY

V. J. DIETRICH¹ (Zürich), A. GANSSE² (Zürich)
and W. E. CAMERON³ (Canberra)

Unmetamorphosed mafic and ultramafic rocks overlain by palaeogene oceanic sediments are exposed on Gorgona Island which is a remnant of the Coastal Cordillera along the Pacific margin of Colombia (Gansser, 1950). Gorgona is one of the rare places in the world where young ultramafic komatiites exhibiting typical quenched spinifex textures occur. The spinifex rocks form lenticular bodies (?lava flows) within cumulate ultramafics and troctolitic gabbros and are closely associated with diabases and pillow basalts of tholeiitic composition.

During a rapid cooling process the order of crystallization was: olivine (Fo₉₀₋₉₁), high Al-calcic pyroxene and chromian spinel being the major quenched phases (Fig. 1), then olivine (Fo₈₆₋₈₂), low Al-calcic pyroxene, plagioclase (An₇₅₋₈₁), and Ti-magnetite as quenched products in the interstitial groundmass (Fig. 2).

Rock composition (wt %) : SiO₂ 44.2, TiO₂ 0.66, Al₂O₃ 12.0, Fe₂O₃ 3.2, FeO 8.2, MnO 0.18, MgO 15.9, CaO 10.1, Na₂O 1.13, K₂O 0.02, P₂O₅ 0.06, H₂O 4.0; trace elements (ppm): Cu 105, Ni 718, Co 93, Cr 1250, Ba <10; depleted in LREE; 100 Mg/(Mg + Fe²⁺) = 77.6.

Outstanding chemical features of these rocks are the high MgO, chromium and nickel contents relative to ocean floor basalts. The olivine compositions seem to be compatible with crystallization from a liquid with magnesium-values corresponding to the bulk rock composition, giving K_D values (ol/rock) of about 0.3. We think that the unusual chemical composition of these rapidly chilled extrusive rocks

¹ Institut für Kristallographie und Petrographie, ETH Zürich, 8092 Zürich, Switzerland.

² Geologisches Institut, ETH Zürich, 8092 Zürich, Switzerland.

³ Department of Geology, Australian National University, Canberra A.C.T. 2600, Australia.

within the close neighbourhood of oceanic crust throws new light on the petrological models of generation of ocean floor basalts.

The olivine control line in Figure 3 indicates that an olivine fractionation of 25 to 30% from a primary liquid similar to that of the Gorgona spinifex rocks could produce the evolved magmas of either olivine tholeiites or plagioclase tholeiites. A detailed petrological study and model calculation involving all major elements, Cr, Ni and some incompatible elements such as Zr, Y and rare earth suggest that to a small amount clinopyroxene and plagioclase must have been also fractionated (Cameron *et al.* in preparation).

We believe therefore that the Gorgona komatiites represent the least modified liquid generated by partial melting of the oceanic upper mantle.

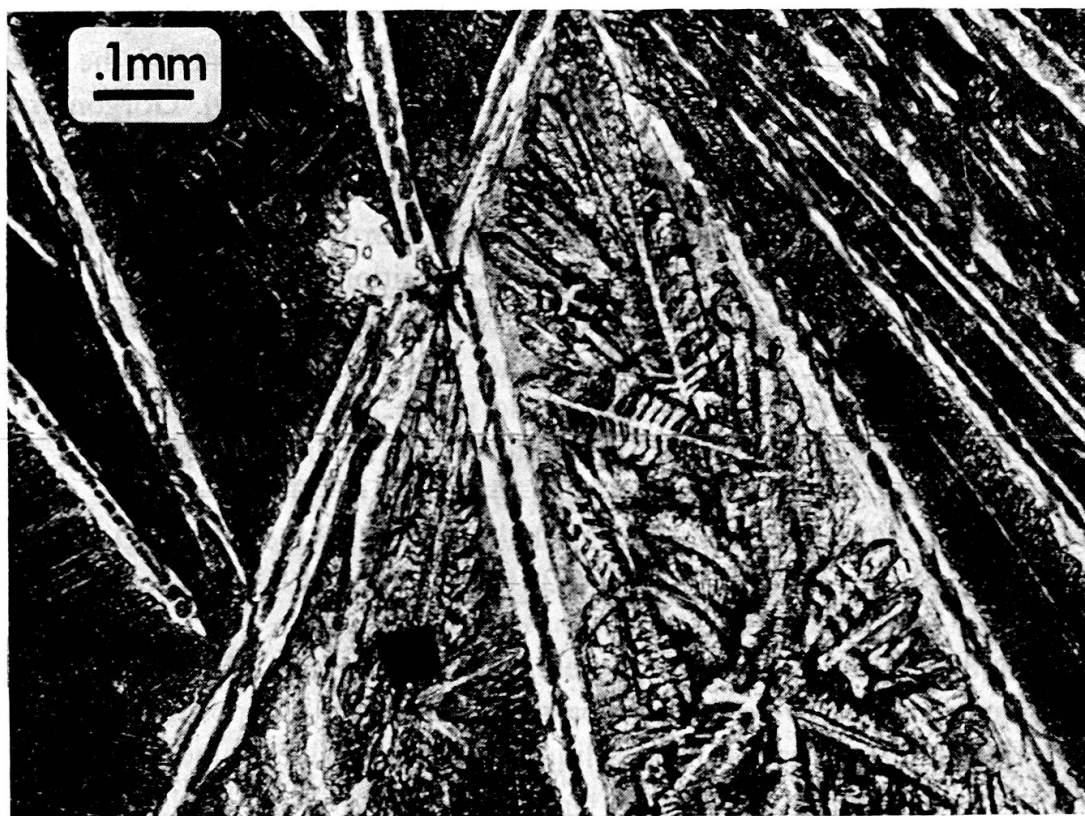


FIG. 1. — Spinifex-textured komatiite from Gorgona island. Sample from the outer most part of an ultramafic lava flow. The weakly serpentinized skeletal plates of olivine (Fo_{90-91}) cause a pronounced octahedral cleavage at the rock surface. The quenched groundmass consists of clinopyroxene aggregates together with euhedral and partly quenched chromian spinel (opaque mineral).

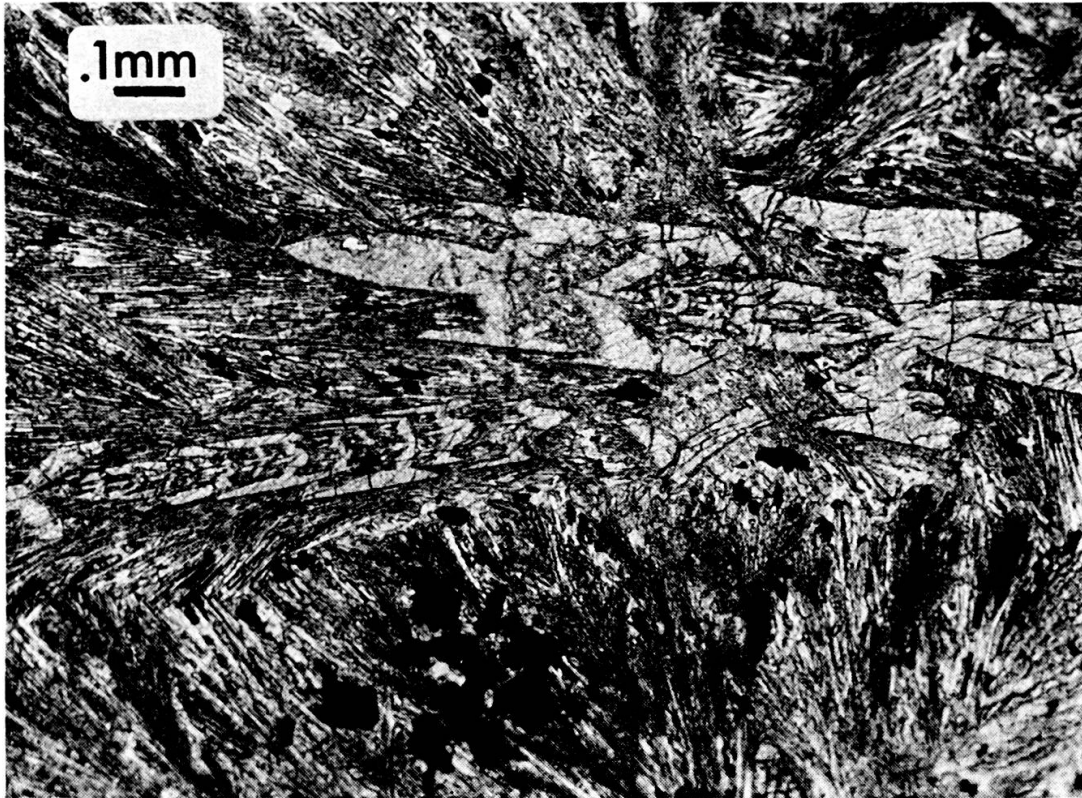


FIG. 2. — Photomicrograph of the inner part of a spinifex-textured lava flow: two large skeletal high-aluminium (up to 13 wt.% Al_2O_3) calcic pyroxenes and euhedral to quenched chromian spinels in a groundmass of plagioclase laths ($\text{L}_{n_{75-81}}$), low-aluminium calcic pyroxenes and Ti-magnetite (small irregular opaque phases). The large quenched olivine plates (Fo_{90-91} with narrow edges of Fo_{85-86}) are not shown in this picture.

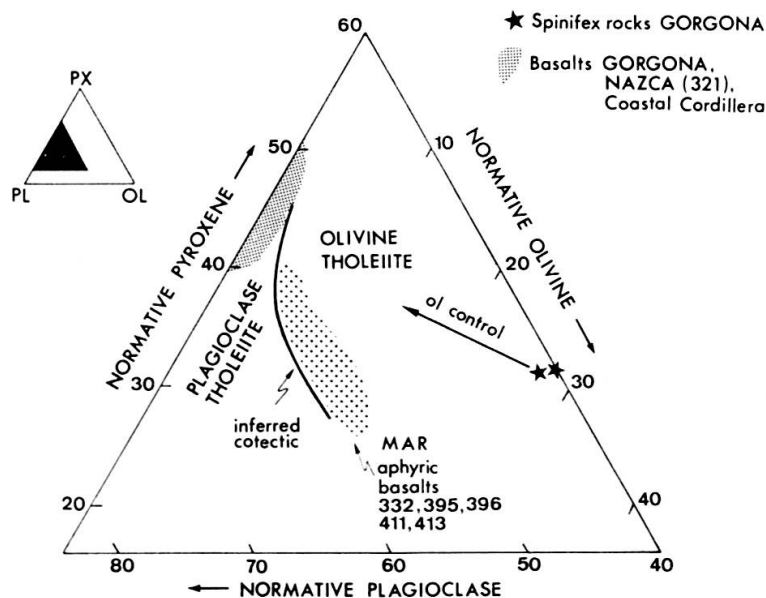


FIG. 3. — Normative olivine-plagioclase-pyroxene relationships between the Gorgona spinifex rocks and aphyric Mid-Atlantic-Ridge basalts (Leg 37, site 332, Blanchard et al. 1976; Legs 45 and 46, Sites 395 and 396, Dungan et al. 1978 and Rhodes et al. 1978; Leg 49, Sites 411 and 413, Wood et al. 1979) and Tertiary basalts from the Pacific (Nazca plate Leg 34, Site 321, Mazzullo and Bence 1976 and Rhodes et al. 1976; Coastal Cordillera, Goossens et al. 1977). The empirically determined olivine-plagioclase cotectic line is from Shido et al. (1971). The slope of the olivine control line has been calculated extracting 10% of forsterite from the Gorgona spinifex rocks.

REFERENCES

- BLANCHARD, D. P., J. M. RHODES, M. A. DUNGAN, K. V. RODGERS, C. H. DONALDSON, J. C. BRANNON, J. W. JACOBS and E. K. GIBSON (1976). The chemistry and petrology of basalts from Leg 37 of the Deep Sea Drilling Project. *J. Geophys. Res.* 81, 4231-4246.
- CAMERON, W. E., V. J. DIETRICH, A. GANSSER and J. SOMMERAUER Evaluation of the Gorgona komatiites as primary magmas for ocean floor basalts (in preparation).
- DUNGAN, M. A., J. M. RHODES, P. E. LONG, D. P. BLANCHARD, J. C. BRANNON and K. V. RODGERS (1978). The petrology and geochemistry of basalts from Site 396 — Legs 45 and 46 of the Deep Sea Drilling Project. *In* : Initial Reports of the Deep Sea Drilling Project 46. Washington, U.S. Government Printing Office, 89-113.
- GANSSER, A. (1950). Geological and petrological notes on Gorgona Island in relation to North-Western S. America. *Schweiz. Mineral. Petrogr. Mitt.*, 30, 219-237.
- GOOSENS, P. J., W. I. ROSE Jr. and D. FLORES (1977). Geochemistry of tholeiites of the basic igneous complex of northwestern South America. *Geol. Soc. Amer. Bull.*, 88, 1711-1720.
- MAZZULLO, L. J. and A. E. BENICE (1976). Abyssal tholeiites from DSDP Leg 34: The Nazca plate. *J. Geophys. Res.* 81, 23, 4327-4351.
- RHODES, J. M., D. P. BLANCHARD, K. V. RODGERS, J. W. JACOBS and J. C. BRANNON (1976). Petrology and chemistry of basalts from the Nazca plate: Part 2 — major and trace element chemistry. *In* : Initial Reports of the Deep Sea Drilling Project 34, Washington, U.S. Government Printing Office, 239-244.
- RHODES, J. M., D. P. BLANCHARD, M. A. DUNGAN, K. V. RODGERS and J. C. BRANNON (1978). Chemistry of Leg 45 basalts. *In* : Initial Reports of the Deep Sea Drilling Project 45. Washington, U.S. Government Printing Office, 447-459.
- SHIDO, F. A., A. MIYASHIRO and M. EWING (1971). Crystallization of abyssal tholeiites. *Contrib. Mineral. Petrol.*, 31, 251-266.
- WOOD, D. A., J. TARNEY, J. VARET, A. D. SAUNDERS, H. BOUGAULT, J. L. JORON, M. TREUL and J. R. CANN (1979). Geochemistry of basalts drilled in the North Atlantic by IPOD Leg 49: implications for mantle heterogeneity. *Earth and Planet. Sci. Lett.*, 42, 77-97.