NOTA GEOLOGICA

JURASSIC ACCRETION OF A HIGH BUOYANCY GUYOT IN SOUTHERNMOST SOUTH AMERICA: THE DIEGO RAMIREZ ISLANDS

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RESUMEN

Las islas Diego Ramírez, en el extremo meridional del continente americano, están formadas por un complejo metamórfico que incluye desde filitas hasta metabasaltos y extensas zonas de 'mélanges'. Estas últimas incluyen clastos de basaltos, cherts y areniscas, en una matriz filítica, afectada por una foliación penetrativa, y estructuras cataclásticas tardías. Los contenidos de elementos mayores y trazas de los metabasaltos son parecidos a los de basaltos toleíticos de intraplaca. En los acantilados orientales de Isla Gonzalo (Punta Clarkson), los metabasaltos cubren estructuralmente a filitas grises de cuarzo-feldespato-muscovita-clorita. Una errorcrona Rb-Sr de cuatro puntos, construida con muestras de esa localidad indica una edad de 169 ± 16 Ma con una razón inicial $^{87}Sr/^{86}Sr$ de 0,70959.

El complejo metamórfico de Diego Ramírez representa una sección del prisma de acreción 'gondwánico' que se extiende desde Chile central hasta la Antártica occidental. Los datos geoquímicos y geocronológicos presentados son consistentes con la hipótesis que en Diego Ramírez estaría registrada la colisión y subsecuente incorporación, dentro del complejo de subducción, de fragmentos de un guyot o monte intraoceánico. Este fenómeno habría ocurrido durante el Jurásico.

Palabras claves: Prisma de acreción, Tierra del Fuego, Jurásico, Gondwana, Chile.
Key words: Accretionary prism, Tierra del Fuego, Jurassic, Gondwana, Chile.

INTRODUCTION

The Diego Ramírez islands lie on the southern edge of the Patagonian shelf, 100 km southwest of Cape Horn. This small group of isolated and ragged islands represents the southernmost tip of the South American continent (Fig. 1a). The islands are characterized by steep cliffs which under prevailing rough sea conditions make landings an hazardous adventure. 'Porphyritic lavas' were mentioned in Diego Ramírez by Jameson (in Wedell, 1825) but the next geological reference appeared only when Aubert de la Rüe (1959) described sericitic 'schistes lustrés' of 'Paleozoic or Precambrian' age. Dalziel (1983) reported additional structural observations, while Wilson *et al.* (1989, and in press) published the first comprehensive geological study of the islands, where reference is made to data here presented. Three of the authors visited Isla Gonzalo in 1981. N. Muñoz and an Empresa Nacional del Petróleo (ENAP) team studied the larger islands in 1984. The purpose of this note is to present the results of geochronological and geochemical studies carried out on samples collected during the above mentioned visits and to discuss their regional tectonic significance.

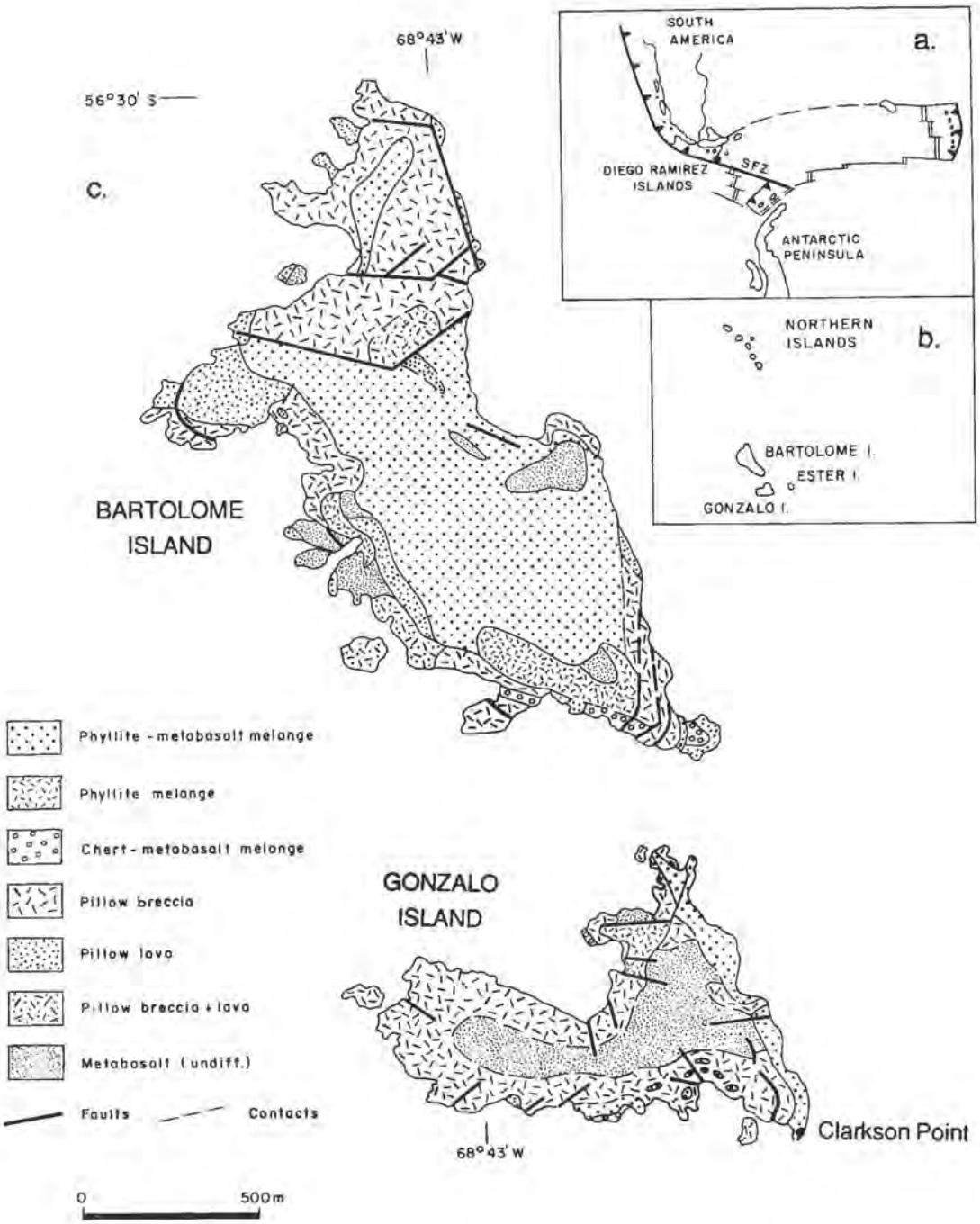

FIG. 1a. Location of Diego Ramirez Islands (**SFZ:** Shackleton Fracture Zone; **SSI:** South Shetland Islands).
1b. Geographic sketch of the island group.
1c. Geological map of Islas Gonzalo and Bartolomé Islands. Adapted from Wilson *et al.* (in press).

GEOLOGY

Fine-grained, pyroxene-bearing, both massive and mélange-interleaved, metabasalts make up most of the islands (Fig. 1c). In the upper levels of exposures pillow structures are well preserved. According to Wilson *et al.* (1989) pillow breccias prevail within the metabasalts. Another lithology recognized by these authors is a phyllite mélange with inclusions of metamorphosed chert, grauwacke, tuff, basalt, and limestone. The metabasalts contain relic plagioclase, and partly cloritized clinopyroxene porphyroclasts in an albite-chlorite-epidote-calcite matrix. Wilson *et al.*, 1989) report that pumpellyite and crossite have been detected by microprobe analyses (Grunow *et al.*, 1987).

White mica-quartz, chlorite and stilpnomelane form the metamorphic assemblage present in the phyllites, where calcite veining is ubiquitous. Three phases of ductile deformation have been recognized by Wilson *et al.* (in press). The first produced a penetrative (S_1) foliation being often transposed in the phyllites by a southwest dipping (S_2) crenulation cleavage related to mesoscopic isoclinal folds. F_3 folds kink the previous surfaces and may be related to pervasive late metamorphic cataclasis, which is held responsible for much of the tectonic mixing in the mélange units.

METABASALT GEOCHEMISTRY

Six metabasalt samples, five showing pillow structures, were analyzed by AAS and XRF (Table 1). DR2 sample, a chloritized Cr-Sr rich, K_2O, Rb, Zr, Y and Nb poor sample, represents a primitive sub-alkaline tholeiite. All others plot in the alkaline field of an Irvine and Baragar diagram. These include DR8, a Ti-rich, calcite veined, ferrobasalt with the highest Nb/Y ratio. DR15, on the other hand, represents the most differentiated rock, which is reflected in its high Zr, Y, Nb contents. There is a good agreement between our data and that of Emslie (*in* Dalziel, 1989); 17 of his 19 samples and all our samples plot inside the within-plate, ocean

TABLA 1. MAJOR AND TRACE ELEMENT ANALYSES, METABASALTS FROM DIEGO RAMIREZ ISLANDS

Sample No.	DR2	DR4	DR8	DR13	DR14	DR15
SiO_2	48.29	45.37	34.47	45.08	46.93	48.17
TiO_2	1.95	2.84	4.17	2.84	2.89	3.10
Al_2O_3	14.61	12.35	15.77	14.91	15.48	15.23
Fe_2O_3	0,44	3.54	10.53	1.04	2.74	2.84
FeO	8.14	6.27	2.84	9.18	10.42	9.09
MnO	0.15	0.15	0.22	0.12	0.13	0.14
MgO	8.04	3.50	1.28	7.69	6.02	5.27
CaO	5.78	11.05	14.16	4.87	3.95	5.19
Na_2O	2.97	4.29	2.97	2.51	3.72	3.52
K_2O	0.06	0.37	2.05	1.28	1.16	1.63
P_2O_5	0.30	0.50	0.31	0.40	0.57	0.64
H_2O+	5.50	3.02	3.02	5.10	4.76	4.46
CO_2	4.09	6.40	8.16	5.03	0.90	1.07
S	0.13	0.04	0.04	0.04	0.05	0.02
C	0.09	0.02	0.01	0.01	0.03	0.07
Total	100.54	99.71	100.00	100.10	99.75	100.74
Cr	310	23	28	230	2	3
Rb	—	5	44	45	24	32
Sr	539	307	380	209	121	252
Zr	150	250	295	202	370	390
Y	13	40	30	29	45	48
Nb	15	27	37	24	39	52

TABLE 2. ANALYTICAL Rb-Sr ISOTOPIC DATA, SAMPLES FROM CLARKSON POINT GONZALO ISLAND

Sample No.	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
DRN6	0.70	225.00	0.0091	0.07098
DR8D	35.70	71.70	1.4388	0.71281
DR7	47.90	17.00	8.1045	0.72759
DR8A	103.00	33.60	8.8494	0.71281

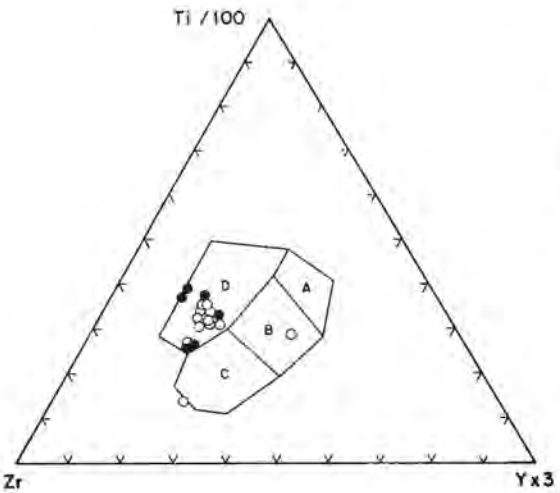

FIG. 2. Ti-Zr-Y diagram of Pearce and Cann (1973) for metabasalt samples from Diego Ramírez Islands. Fields **A** and **B:** Low K tholeiites; **B** and **C:** Calc-alkaline basalts; **D:** Within-plate basalts (includes ocean island basalts). Open circles: data from Emslie (*in* Dalziel, 1989).

island basalt field of a Zr-Yx3-Ti/100 diagram (Fig. 2).

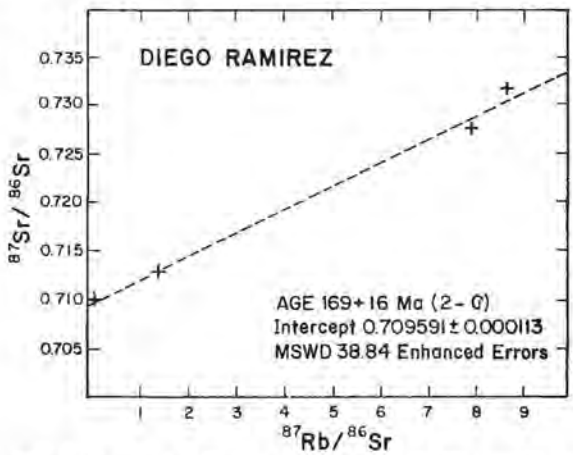

FIG. 3. Four point, Rb-Sr errorchon, for phyllite samples from Clarkson Point, Isla Gonzalo.

GEOCHRONOLOGY

A four point whole rock errorchron using mainly phyllite samples from Clarkson Point, Isla Gonzalo (Fig. 1) gives a 169 ± 16 Ma age with a 0.70959 initial ratio (Fig. 3, Table 2). Because most phyllites lack strain markers, it is difficult to assess which structural fabric is dominant in the outcrop. Most likely, however, the dated metamorphic event corresponds to the time of formation of the dominant F_2 fabric.

DISCUSSION

The observations of the authors and geochemical data are compatible with the interpretation advanced by Wilson *et al.* (1989) and Dalziel (1989), who considered the rocks of this islands as within-plate basalts, tectonically interleaved with trench sediments in an accretionary complex. Both the multistage deformed mélanges and the chemical signature of the metabasalts point to such a tectonic environment. The large amount of alkaline tholeiites present in the islands could result from the collision of a positive high buoyant topographic feature as a guyot or seamount, slices of which were subsequently incorporated within the accretionary prism.

The Diego Ramírez Islands belong to a long belt of fore-arc assemblages accreted to the 'southwestern' margin of Gondwanaland. A protracted history of subduction has gradually been recognized in different sections of this belt. In the Chonos archipelago subduction related metamorphism has

been dated by Rb-Sr methods between the upper Paleozoic and lowermost Cretaceous (Godoy *et al.* 1984; Davidson *et al.*, 1987). Further south in the Madre de Dios-Estrecho Nelson area, Forsythe and Mpodozis (1983) described high P/T metamorphic assemblages and basalts of both ocean floor as well as within-plate affinities, accreted sometime between the Lower Permian and the Middle Jurassic. Finally, upper Paleozoic to lower Tertiary ages have been reported from the Scotia Metamorphic Complex, Western Antarctic (see, for example, Dalziel, 1972; Hervé *et al.*, 1989).

The continental shelf in the Cape Horn region is partly covered by the infill of a large forearc basin, an uplifted part of which crops out at Islas Ildefonso (Mpodozis, 1980) (Fig. 4). Pollen and fitoplancton from its lower turbidite sequence indicate a Paleocene to Lower Eocene age (ENAP[1]). According to our limited radiometric data, the main metamorphic event in the basement of this basin (*i.e.* the Diego Ramírez Complex) could be restricted to the Middle Jurassic.

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