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GEOSUR 2004: Mesozoic to Quaternary evolution of Tierra del Fuego and neighbouring austral regions I

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The impetus for the publication of thematic issues on Tierra del Fuego geology and geophysics born from the wealth of new information presented at **Geosur International Symposium** held in Buenos Aires, Argentina, in November 2004. The first aim of the organizing committee of **Geosur 2004** was to provide sets of synthetic papers that could provide a rather comprehensive review of the geological and geophysical knowledge of the Tierra del Fuego region; a second aim was to publish more specific papers focused on subjects still under study and debate, including original contributions from Tierra del Fuego and neighbouring areas of the Patagonian Andes and Scotia plate.

From the first geographical exploration in the sixteenth century to the modern geophysical researches in the southern oceans, various approaches to the knowledge of the Tierra del Fuego have been proposed by different geological schools from Argentina, Chile, Italy, Scandinavia, North America and many others countries. Since long time, this remote region of the world has stimulated the curiosity and the fantasy of many researches in natural sciences and in particular in geological sciences. Among the pioneering works on Tierra del Fuego geology are the first descriptions of Cretaceous "*clay-slate broken by dikes*" and the recognition by Darwin, during his voyage on the HMS Beagle in 1834, of the metamorphic origin of the glacial boulders in the north eastern part of the Island (Darwin, 1845). It must also be mentioned the first geological map of the Island by Bonaraelli (1917; Fig. 1) since it synthesized all the geological information then available and still now it agrees with the modern geological studies.

Tierra del Fuego Island presents a complex geological and structural architecture comprised between the Chile trench in the west and the transform boundaries of the western Scotia Sea in the south. The geodinamic history can be synthetized starting from the Mesozoic in the southern margin of the Gondwanaland, when an extensional Jurassic-Early Cretaceous phase was followed by the Late Cretaceous collisional events, with the formation of the Andean Cordillera and the Magallanes and Malvinas foredeep basins. The Cenozoic evolution of this orogen in the southern tip of South America was strongly influenced in the Oligocene by the opening of the Scotia Sea, with the splitting of the Antarctic Peninsula and with the superposition of important transform faults. The last glacial events modelled and contributed to the present landscape.

This first thematic issue in Geologica Acta presents contributions from a wide disciplinary scope that includes Geodesy, several geophysical techniques (Paleomagnetism, Gravimetry, Seismic reflection and bathymetric studies) and Geomorphology. The second thematic issue in the same journal (Menichetti and Tassone, in press 2008) will include new contributions focused on Strati-

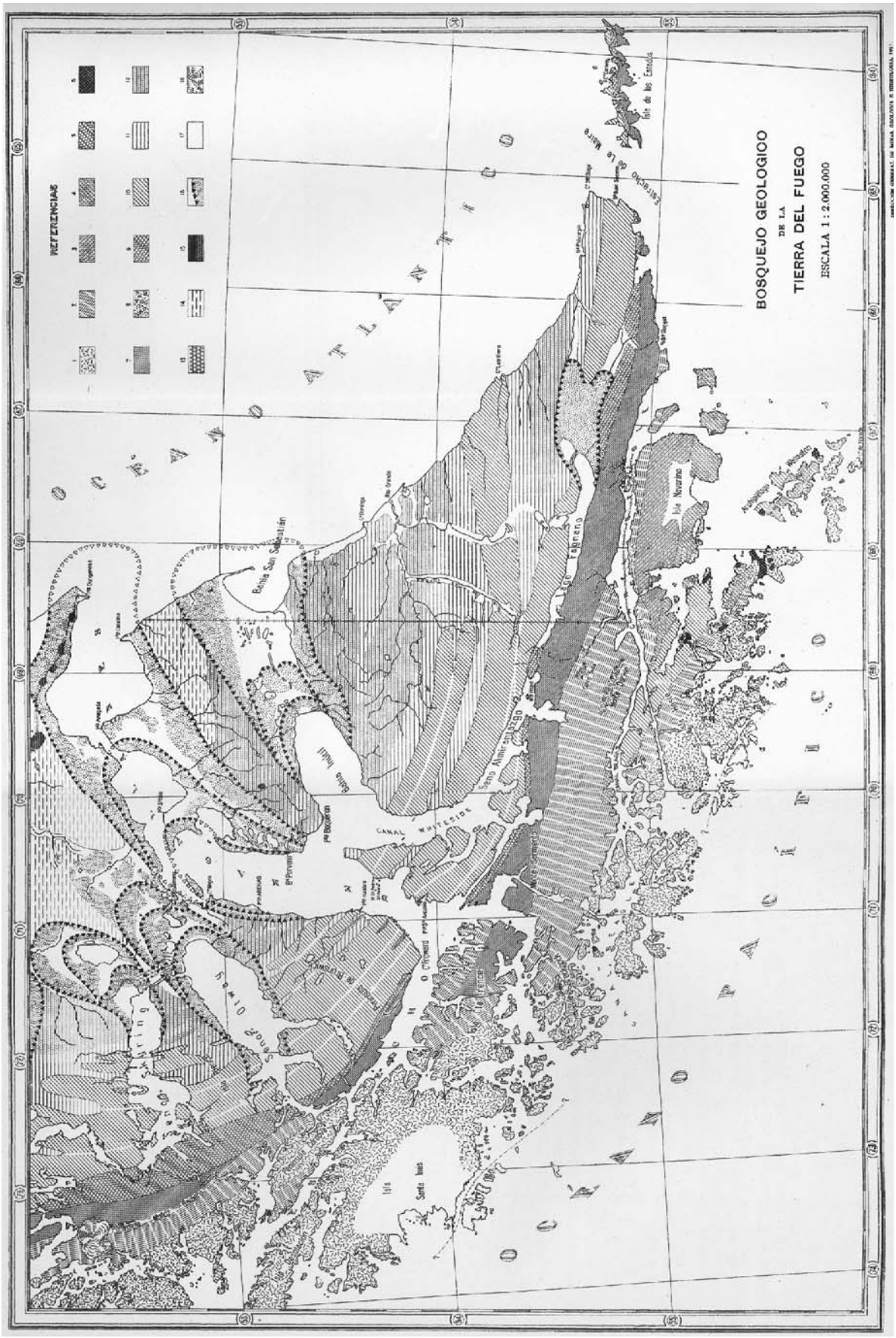

FIGURE 1 | **Reproduction of the first geological map of Tierra del Fuego (Bonarelli, 1917). A) Batholith facies. 1: Diorite to granite batholith facies. B) Batholith roof. 2: Metamorphic schists; 3: Feldspar schists (Lower group); 4: Feldspar schists (Upper group); 5: Microgranulites. C) Ancient eruptive rocks. 6: Propylites. D) Metamorphic series with intrusive and eruptive rocks. 7: (Paleozoic) schists; 8: Granite laccoliths; 9: Quartz prophyries, tuffs and associated rocks. E) Mesozoic-Quaternary record. 10: Jurassic-Cretaceous Series; 11: Lower Cenozoic marine horizon 12: Upper Cenozoic marine horizon 13: Basal Cenozoic continental conglomerate; 14: Sands, tuffaceous clays and true tuffs (Santacruceana Series)- continental Cenozoic; 15: Basalts; 16: Distal moraines; 17: Quaternary deposits; 18: Monte Burney volcano.**

graphy, Structural Geology, Petrology, Seismostratigraphy and Hydrocarbon exploration.

The long-lasting debate about the orogene *vs*. orocline nature of the Fuegian Andes is addressed on paleomagnetic grounds (Rapalini, this issue). The revision of the available paleomagnetic data in the southern Patagonian and Fuegian Andes reveals systematic counterclockwise rotations, which might indicate the secondary orogen curvature. However, the variable quality of these revised paleomagnetic data hinders a conclusive definition of the southernmost Andean curvature.

New insights into the dynamics and evolution of the Chile trench between 50°S and 56°S are provided by seismic reflection profiles combined with satellite derived gravity maps (Polonia and Torelli, this issue), which reveal varying frontal wedge morphology, different rates of accretion and underthrusting and a high degree of structural diversity within the accretionary wedge. Taking into account structural style, internal deformation, and seafloor morphology, the authors distinguish four domains within the studied portion of the Antarctic/Scotia plate boundary. The segmented character of the continental margin would be controlled by oblique structural trends belonging to the Scotia/South America plate boundary.

A synthetic picture of the onshore anatomy of the Magallanes-Fagnano deformation zone is provided by means of gravity and bathymetric data of the central-eastern part of the Isla Grande de Tierra del Fuego (Lodolo et al., this issue). The regional gravity anomaly trend shows a progressive southward negative gradient over which broadly E-W-trending gravity minima are superimposed. The authors interpret these relative minima as representing elongated and narrow sedimentary basins formed within the principal displacement zone of the Magallanes-Fagnano transform system. The presented bathymetric map of the Lago Fagnano, in turn, reveals a partitioned asymmetric lake basin with flat depocenters as generally found in similar pull-apart settings developed within transform systems.

Del Cogliano et al. (this issue) present an improvement of the previously known regional geoid (based on classical GPS levelling and gravimetric data) of Tierra del Fuego. The authors expose the results of a successful experiment directed to determine the equilibrium water surface topography of Lago Fagnano -inaccessible for classical GPS levelling and gravimetric data acquisition. The employed method measured the ellipsoidal mean surface heights of the water body using a GPS buoy and tide gauges and the achieved accuracy is comparable with that of GPS levelling. Moreover, the derived geoid undulations show a strong correlation with the local mountains and the lake floor topography.

Combined bathymetry and gravity data allowed modelling the crust-mantle interface of the Early Miocene Powell Basin (Chávez et al., this issue). This is a small ocean basin located within the Antarctic Plate close to the limit with the Scotia Plate. Mean depth of the crust-mantle interface in the Powell Basin is estimated in 13.5 km. The modeled 3D geometry -computed by numerical inversion methods- of the crust-mantle interface provides evidence of a NW-SE oriented axis, which supports the inferred existence of inactive spreading ridges within the basin. Increase in the modeled crustal thickness toward the continental margins is considered as resulting from the asymmetric nature of the basin.

The Quaternary evolution of two contrasting coastal areas of Tierra del Fuego is provided by Bujalesky (this issue): the northeastern Atlantic coast and the Beagle Channel. The former is located at the extra Andean lowlands within the South-American Plate where the southernmost Pliocene and Pleistocene beaches recorded in the world occur. This area was a free-ice area since 1.8 Ma B.P. During the Holocene gravel barriers plugged the inner estuaries of the palaeoembayments suggesting a relative sea level fall of 0.214 m each 1,000 years. The Beagle Channel is a 300 m depth basin running between the Pacific and Atlantic oceans, located at the active seismic-tectonic setting of the Fuegian Andes within the Scotia Plate. This 5 km wide tectonic valley was covered by ice during the Last Glaciation and was rapidly flooded by the sea immediately after the Younger Dryas, 11,000 year B.P. Holocene raised beaches along the channel allow estimating the average tectonic uplift for this period ranging from 1.5 to 2.0 mm/year.

As a final linguistic note, it must be emphasized that in the papers presented here the terms Fuegian and Fueguian are synonymous and both are used as adjectives meaning “of Tierra del Fuego” or “pertaining to Tierra del Fuego”.

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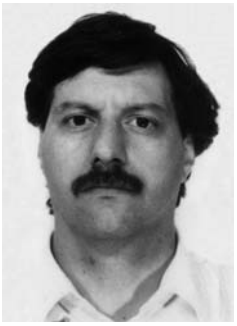

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