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Oceanography of the Chilean Patagonia

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ABSTRACT

Chilean Patagonia is one of the most extended fjord regions in the world that covers nearly 240,000 km^2 with an extremely complex coastline and topography in one of the least densely populated areas of the country (1–8 inhabitants every 10 km^2). In recent years, the area has been undergoing somewhat intense pressure since several commercial projects in hydroelectricity, tourism, and commercial salmon and mytilid cultures have been developed, or are in progress. Concomitantly, several large research programs have been devised to study the physical, chemical, and biological environment of Patagonia, such as the CIMAR FIORDO, and recently COPAS Sur-Austral based at Universidad de Concepcion, that attempts to close the bridge between oceanographic knowledge and its use by society.

In this introductory article we summarize the collection of papers comprising this Special Issue of Continental Shelf Research. These papers deal with aspects of regional oceanography and geology, inorganic and organic geochemistry, ecology of pelagic and benthic organisms, and past changes in productivity.

1. Introduction

Chilean Patagonia is one of the most extended fjord regions in the world, located on the southeastern border of the Pacific Ocean extending from 41.5°S (Reloncaví Fjord) to 55.9°S (Cape Horn), covering 240,000 km^2 (Fig. 1), and composed of many islands, peninsulas, fjords, and channels that leave the landscape with a rugged coastline of about 1000 km in a straight line, but of ca. 84,000 km of coastline, 20-fold longer than the Chilean continental coastline (Silva and Palma, 2008). This is an area of low population density ranging from one inhabitant every 10 km^2 (such as the Arturo Prat province) to 0.8 inhabitants per square kilometer (Aysen region).

The Chilean fjords and channels receive fresh water from local rivers, surface runoff, and groundwater flows fed by high rainfall (100–700 cm year^{-1}, MOP-DGA, 1987), and glaciers. Rivers Baker (1,133 m^3 s^{-1}), Pascua (753 m^3 s^{-1}), and Bravo (112 m^3 s^{-1}) are located at ca. 48° S; Aysén (283 m^3 s^{-1}) and Cisnes (253 m^3 s^{-1}) at ca. 45° S; Puelo (678 m^3 s^{-1}), Petrohué (278 m^3 s^{-1}) flowing into the Reloncaví fjord, and Yelcho (363 m^3 s^{-1}) into the Corcovado Gulf (Dirección General de Aguas de Chile, www.dga.cl). Temperature ranges between 5.5 °C at 54°S and 11 °C at 42°S (Miller, 1976).

Fjords are high latitude estuaries that are usually longer than they are wide, with relatively deep water columns and presenting steep walls. They were formed by erosion due to the advancement and retreat of glaciers during the last ice age, and filled with seawater during high sea level in the interglacial. Fjords undergo estuarine circulation due to the occurrence of a river discharging at their most upstream point. The irregular bottom topography and the presence of several sills enhances deposition of sinking particles and may slow down circulation. Even though low oxygen concentration has been detected (ca. 100 μM), in the Chilean fjords, no anoxic basins have been found. That contrasts with some fjords in the Oslofjord and the Framvaren in Norway, and in Saanich Inlet in British Columbia.

The Chilean Patagonia is also characterized by the presence of five large Ice Fields (Northern Patagonian, Southern Patagonian, Muñoz-Gamero Peninsula, Santa Inés Island, Darwin Mountain), considered valuable fresh water reservoirs of worldwide importance (for instance, the Southern Ice Field provides ca. 3000 m^3 water s^{-1} to the ocean, and it is world's third most important reserve of fresh water after Antarctica and Greenland). These ice fields are unique at these latitudes (46–48°S) and are conserved due to atmospheric and oceanic circulation patterns. Pickard (1971) pointed out that the influence of glaciers on oceanographic features is more pronounced in southern Chile than in the fjords of Alaska and British Columbia. For instance, Secchi disc values of only 1 m, affected by glacial silt, were measured up to 80 km from the

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