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Characterization of alteration minerals in Deception Island (Antarctica): implications for the dynamics of the current hydrothermal system

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Hydrothermal systems, commonly developed in volcanic calderas, play an important role on the type and location of the post-caldera volcanic activity. The hydrothermal alteration and mineral precipitation can modify the physical properties and mechanical behaviour of the affected rocks, with the progressive alteration facilitating the occurrence of phreatic or hydrothermal explosive eruptions. Deception Island (South Shetland Islands) is one of the most active volcanoes in Antarctica, with more than 20 eruptions and three documented unrest periods over the past two centuries. The island consists of a composite volcano with an 8.5 x 10 km centrally located caldera dated at c. 8,300 years, according to paleomagnetic data, and 3,980 ± 125 calibrated years before the present (cal yr BP) based on tephrochronology, sedimentological studies and ^{14}C dating. After the caldera-forming event, volcanic activity has been characterized by monogenetic magmatic and phreatomagmatic eruptions located around the caldera rim. Also, a hydrothermal system developed in the Port Foster area, although no detailed study has been done so far. The aim of this work is to shed further light in the dynamics of Deception Island hydrothermal system by studying several representative samples of magmatic rocks. A detailed petrographic study and a characterization of primary and secondary minerals have been carried out. The presence of secondary minerals and the palagonite alteration in the Fumarole Bay Formation suggest that the alteration of the samples took place under conditions of low water/rock ratios, basic pH and temperatures below 200 °C. The secondary minerals from the Basaltic Shield Formation samples may be indicative of fluids with temperatures higher than 200 °C and richer in CO_2. Finally, the physical changes observed in the samples of this study lead to the conclusion that the investigated areas of the Fumarole Bay Formation are more likely to host hydrothermal or phreatic explosive eruptions, compared to the Basaltic Shield Formation zones.

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