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A PRESSURE-RESISTANT SELF-CONTAINED OFFLINE TEMPERATURE MEASUREMENT DEVICE FOR VARIOUS POLAR ICE BOREHOLE ENVIRONMENTS

Accurate measurement of temperature within Antarctic ice holes is crucial for understanding the thermal state of ice sheets and subglacial environments, especially for the study of ice sheet dynamics, subglacial heat flux, and the broader Antarctic thermal environment. However, conventional temperature-measuring devices become inapplicable in ice boreholes due to extreme cold, high pressure, and the corrosiveness of drilling fluids. We have developed a new device, named iBOLT (ice Borehole Offline Logger of Temperature), that provides a simpler, portable, and efficient solution for downhole temperature measurement in the Antarctic. The iBOLT device can measure temperatures in various environments within the range of -45℃ to +85℃ (±0.1℃ accuracy), withstand pressures up to 40 MPa, and can be used in a Φ80 mm borehole, thus highly suitable for temperature measurement in Antarctic ice holes, subglacial lakes, and other liquid environments requiring temperature monitoring. It is powered by a self-contained power supply and can continuously record temperature for more than 50 days with a data interval of 1 minute. All the recorded data can be read, exported, and stored via Bluetooth after being recovered to the surface. Laboratory tests and field borehole applications of iBOLT show that temperature readings stabilize within 10 minutes in liquid environments. Therefore, surface personnel only need to record the time and the corresponding depth. In this study, we present the development process of the iBOLT temperature measurement device, including structural design, simulation analysis, testing procedures, and results from field borehole applications.

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