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Smart seismic instrumentation for volcanic networks

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Recent technological advances in broadband seismic instrumentation allow operators to increase station density and installation flexibility on active volcanoes while increasing the observable frequency bandwidth compared with traditional geophone arrays.

Large quantities of instruments increase the footprint or increase the density of an array due to reduced costs of sensors and improved power specifications requiring less auxiliary equipment. This also allows installation in previously inaccessible areas due to portability, widening the scope of array design.

Traditionally, the Güralp 6-series and 40-series instruments have often been popular on volcanic sites due to their ruggedness and simplicity to operate. Advances in Güralp's pioneering engineering mean that operators are increasingly looking towards new instrumentation: Certimus and Certis.

This new family of instruments presents digital and analogue options of a triaxial broadband sensor that functions at any angle without any need for human intervention. This is especially useful for rapid installations where time is of the essence; there is no need to level the instrument during installation, vastly reducing field complications and deployment times. This feature has been extensively deployed in glacial regions of Iceland where instrument tilt would have prevented previous installations but where the Certimus has triumphed in providing data on sub-glacial volcanic activity.

A user-configurable long period corner between 120s, 10s and 1s allows the operator to alter the response of their instrument depending on the requirement after delivery. Therefore, an array of short-period sensors is immediately adjusted to become a long-period array either locally or remotely.

Sub-300mW power consumption means both Certimus and Certis can be deployed with very small batteries and solar panels. GSL has also developed a compact lithium-ion battery pack to be used with the instruments for the very purpose of remote installations where lead-acid batteries cannot be transported.

Beneath the surface, the same technology is deployed in boreholes and postholes through the narrow-diameter Radian seismometer. A network of 17 Radian instruments is deployed across Mount Teide on the island of Tenerife, cored into the volcano itself to improve noise performance

in this remote area.

When utilising instruments such as Certis and Radian that require a datalogger, the Güralp Minimus provides scope for incorporating other auxiliary meteorological, geochemical or geophysical sensors into a single station. As standard, the Minimus increases the number of analogue input channels beyond what is required for a triaxial seismometer which in turn increases the possibility of an observatory-style station.

In addition to land-based technology, Güralp has supplied several Ocean Bottom Seismometer (“OBS”) systems to clients monitoring volcanic activity at axial seamounts. As well as using cabled OBS systems, autonomous units are deployed to increase the spatial footprint of volcanic island arrays and therefore gain greater understanding of volcanic structure at depth.