Monitoring submarine volcanic eruptions and drifting icebergs in the South Pacific Ocean

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Volcanic Activity:
Monowai volcano, Kermadec arc, was discovered in 1977: a patch of brown and turbulent water was observed by Royal New Zealand Air Force. The summit of the seamount is now 130m deep. Since 1988, the Laboratoire de Géophysique, CEA/DASE, uses its ‘T Phase’ stations to monitor closely the submarine hydroacoustic activity of the seamount.

Since May 24, 2002, Monowai volcano is in constant activity. Several Sea Beam surveys have shown at least two dramatic changes of the volcano: in May 24, 2002, a very strong T wave was associated with a SE sector collapse. A second slide was identified on the SW slope between 2004 and 2007 but could not be associated with a strong T wave because the RSP network was shadowed by the edifice. Since 2002, cyclic collapses and regrowth of the volcano generates episodic swarms of T waves of different shapes and origin: hour-long tremors, submarine explosive activity, very shallow volcano-seismic earthquakes. The continuous real-time seismic recordings of RSP Network enable to follow all the stages of Monowai eruption. IMS H03N hydrophones are occasionally very useful to constrain the localization of particular Monowai sources and to reduce the size of error ellipse.

At present, Monowai is still continuously sending out T waves. LDG has frequent contacts with the Institute of Geological and Nuclear Sciences of New Zealand to keep them informed.

RSP Network records numerous T waves from Antarctic icebergs. During summer 2008-2009, we particularly studied the giant iceberg B15A. The parent iceberg of B15A calved off the Ross Ice Shelf in 2000, and broke up into several pieces. B15A, 27 x 122km, the size of Long Island, NY, slowly moved in the Ross Sea, broke Drigalsky Ice Tongue in 2005 and began to drift in the Pacific towards north in mid 2008. In October 2008, it was near 56°S, 167°W. Between November an February, we detected 798 hydroacoustic events coming from Pacific-Antarctic Ocean, and 412 events were located with RSP and H03N data. The T phases were very short, with a weak to medium amplitude. They were different from T phases of colliding icebergs. K. Stuart, from MERS Lab, BYU, provided us with accurate Qscat tracking positions of B15A, and LAADS, NASA, made available high resolution images of Terra and Aqua MODIS instrument. These data gave us the opportunity to track closely the drift and final breaking-up of this icy giant.

Drifting Icebergs:
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Many T waves marked out the drift and the progressive crumbling of B15A. Finally, on December 27, at 03:22, an unusual swarm of T waves indicated that knife-shaped B15A was breaking up into 4 pieces. We found that the most of the hydroacoustic events where generated by B15A, but some of them came from small melting pieces. The source mechanism of these hydroacoustic events was not clearly known, but the locations and some anomalies of amplitude suggested that the sources were due to cracks at the periphery of B15A.

Hydroacoustic activity of Monowai since 2002: cumulated number of events.

May 5, 2009

RSP ‘T Phase’ stations waveforms from Monowai.

Hydroacoustic source locations (orange circle) during December 2008 with error ellipses, track of B15A in red, and known QScat positions (MERS Lab.) in December (green stars). In yellow, the QScat position of a son of B15A.

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