A comparison of seismically imaged hydrothermal vents with field and laboratory analogues

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Intrusion of igneous sills into a sedimentary basin can cause thermal maturation of organic matter and the generation of significant quantities of greenhouse gases - methane and carbon dioxide. At the same time, pressure can build to the point of rupturing the overlying strata to form a hydrothermal vent, causing an explosive eruption of the gases to the ocean and atmosphere.

Such sudden releases of greenhouse gases hold the potential to cause rapid global climate change. As an example, methane generated next to North Atlantic Igneous Province sills has been postulated to be responsible for the Paleocene-Eocene Thermal Maximum. However, both methane and carbon dioxide have finite residence times in the atmosphere. If these gases were delivered to the atmosphere slowly, they would be removed by natural processes before they could significantly affect climate. Hence, to draw any conclusions as to the importance of sill-vent complexes in causing climate change, we must know the flux of these gasses up the conduit. Little work has been carried out to address this issue.

We present brand new images of hydrothermal vents made by running spectral decomposition on a high resolution 3D seismic dataset from the Bass Basin in southern Australia. This technique has allowed us to image the vents and their conduits to a much higher level of detail than ever before. A comparison of several of these newly imaged vents is made with field studies on the morphology of supra-sill hydrothermal vents and kimberlite pipes, and with laboratory experiments on diatremes. The vent morphologies are used to place bounds on the likely flux of gases through the vent, and also on the duration of explosive activity, in order to shed light on their importance in causing rapid global climate change.

Anatomy of the onset of the current repose period at Volcán de Colima during July 2011

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After nearly 13 years of continuous activity which included multiple periods of lava-dome extrusion and explosive activity, Volcán de Colima (VdC) in Mexico ceased erupting in July 2011. Historical activity at VdC has been dominated by two century-long cycles, 1814-1913 and 1913-present, with the transition between these cycles marked by a major eruption in 1913, which occurred after a period of quiescence (Luhr and Carmichael, 1980). We have used a suite of statistical tools (including detrended fluctuation analysis and spectral analysis) to analyse the 13 months of continuous volcano-seismic data collected in the period up to and including the beginning of the repose period. These statistical techniques will be used to investigate whether there are any detectable changes in the characteristics of seismic timeseries which may give clues to the process or processes that may have led to the cessation in activity. These statistical techniques have previously been shown to work well when analysing fluctuations in the behaviour of both VdC (e.g. Varley et al., (2006), Lachowycz et al., (2013)) and Soufrière Hills, Montserrat (e.g. Nicholson et al., (2013). The aim of this work is to improve our recognition and understanding of the nature of eruptive pauses during long-lived dome-forming eruptions.

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