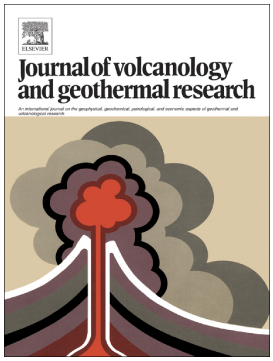

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Thermal power of Grímsvötn, Iceland, from 1998 to 2016: quantifying the effects of volcanic activity and geothermal anomalies

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Abstract

Grímsvötn lies beneath the centre of the Vatnajökull ice cap, Iceland, and has for centuries been one of the most geothermally active calderas in the world as well as being Iceland's most active volcano. Calorimetric studies of its heat output have suggested long-term heat release of 2–4 GW. We have performed a detailed study of the heat release at Grímsvötn over the period 1998–2016, which includes the eruptions of 1998, 2004 and 2011. Annual mapping of the ice surface is used to monitor ice volume changes, combined with results of mass-balance monitoring over this same period. We estimate an average heat release of 1800±200 MW, whereof about ~1200 MW is the base geothermal heat flux. The remaining ~600 MW is an average over the study period, composed of peaks above the base flux from melting during eruptions and geothermal anomalies. The most intense melting occurred at eruption sites during eruptions. Less intense signals lasting several months to years were due to increased geothermal melting creating new ice cauldrons and deepening pre-existing ones. Such thermal anomalies were observed both as precursors to the eruptions, and in the 2–3 years following. The strongest signal followed the 1998 eruption which produced an average of 650 MW in the two years following. After the 2004 eruption a thermal anomaly of 500 MW was observed in the following years, and an average signal of 450 MW followed the 2011 eruption. These thermal signals demonstrate a post-eruption link to increased geothermal activity at the caldera walls.