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Estimates of gas release at the LUSI sediment-hosted hydrothermal system, Java, Indonesia

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Lusi is a sediment-hosted hydrothermal system located in North-East Java, Indonesia. This eruption has been actively bursting boiling mud breccia, oil, gas, and water since the 29th of May 2006 and today occupies a region of 7 km2. Over this large area are scattered thousands of active seepage sites that surround a 100 m diameter central vent characterized by a geysering behaviour. Geophysical, petrography, and geochemical investigations revealed that Lusi is fuelled by a magmatic intrusion at depth, and that hydrothermal fluids migrate from the neighbouring Arjuno-Welirang volcanic complex and into the Lusi conduit zone.

A dedicated survey was designed 1) to estimate the type and the amount of gas released both from the seeps and from the central vent, and 2) to map the preferential pathways for the fluids migration. Besides aqueous vapour, CO_2 and CH4 represent the main gases released from Lusi. Results show that the areas of intense degassing are along fractured zones of the NE-SW oriented Watukosek fault system. This fault system connects Lusi with the neighbouring volcanoes. The whole area surrounding the crater releases primarily CH4 from thousands of satellite seeps and by invisible diffuse seepage. In contrast, the central vent is CO_2–dominated both during the quiescent and geysering phases. Our estimates show that, since the beginning of its activity, Lusi has released carbon into the atmosphere in the order of Mt units.

Lusi is unique on Earth today, but has several characteristics in common with the so-called hydrothermal vent complexes from the geological past. The hydrothermal vent complexes were formed as a result of degassing in sedimentary basins affected by Large igneous provinces, and may be responsible for rapid climate changes such as the Toarcian event and the PETM. We argue that Lusi represents the only modern analogue for these palaeo systems. Therefore, quantification of the Lusi degassing holds the promise for a better understanding of the dynamics of deep time carbon degassing from sedimentary basins.