Monitoring natural CO2 flow in the mofettes of the West Bohemia seismoactive region

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Monitoring of CO2 degassing in seismoactive areas allows the study of correlations of gas release and seismic activity. Reliable continuous monitoring of the gas flow rate in rough field conditions requires robust methods capable of measuring gas flow at different types of gas outlets such as wet mofettes, mineral springs and boreholes. In this paper we focus on the methods and results of the long-term monitoring of CO2 degassing in the West Bohemia/Vogtland region in Central Europe, which is typified by the occurrence of earthquake swarms and emanations of carbon dioxide of magmatic origin. Besides direct flow measurement using flowmeters, we introduce a novel indirect technique based on quantifying the gas bubble contents in a water column, which is capable of functioning in severe environmental conditions. The method calculates the mean bubble fraction in a water-gas mixture from the pressure difference along a fixed depth interval in a water column. Laboratory tests indicate the nonlinear dependence of the bubble fraction on the flow rate, which is confirmed by empirical models found in the chemical and nuclear engineering literature. Application of the method in a pilot borehole shows a high correlation between the bubble fraction and measured gas flow rate. This was specifically the case of two coseismic anomalies in 2008 and 2014, when the flow rate rose during a seismic swarm to a multitude of the pre-seismic level for several months and was followed by a long-term flow rate decline. However, three more seismic swarms occurring in the same fault zone were not associated with any significant CO2 flow anomaly. We surmise that this could be related to the slightly farther distance of the hypocenters of these swarms than the two ones which caused the coseismic CO2 flow rise. Further long-term CO2-flow monitoring is required to verify the mutual influence of CO2 degassing and seismic activity in the area.