Geophysical Research Abstracts
Vol. 16, EGU2014-12642, 2014
EGU General Assembly 2014

Dike intrusions during rifting episodes obey scaling relationships similar to earthquakes

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Rifting episodes accommodate the relative motion of mature divergent plate boundaries with sequences of magma-filled dikes that compensate for the missing volume due to crustal splitting. Two major rifting episodes have been recorded since modern monitoring techniques are available: the 1975-1984 Krafla (Iceland) and the 2005-2010 Manda-Hararo (Ethiopia) dike sequences. The statistical properties of the frequency of dike intrusions during rifting have never been investigated in detail, but it has been suggested that they may have similarities with earthquake mainshock-aftershock sequences, for example they start with a large intrusion followed by several events of smaller magnitude. The scaling relationships of earthquakes have on the contrary been widely investigated: earthquakes have been found to follow a power law, the Gutenberg-Richter relation, from local to global scale, while the decay of aftershocks with time has been found to follow the Omori law. These statistical laws for earthquakes are the basis for hazard evaluation and the physical mechanisms behind them are the object of wide interest and debate. Here we investigate in detail the statistics of dikes from the Krafla and Manda-Hararo rifting episodes, including their frequency-magnitude distribution, the release of geodetic moment in time, the correlation between interevent times and intruded volumes. We find that the dimensions of dike intrusions obey a power law analogous to the Gutenberg-Richter relation, the long-term release of geodetic moment is governed by a relationship consistent with the Omori law, and the intrusions are roughly time-predictable. The need of magma availability affects however the timing of secondary dike intrusions: such timing is longer after large volume intrusions, contrarily to aftershock sequences where interevent times shorten after large events.