WAS THE FEBRUARY 2008 BUKAVU SEISMIC SEQUENCE ASSOCIATED WITH MAGMA INTRUSION?

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Abstract

On February 3rd 2008, a Mw 5.9 Earthquake struck the cities of Bukavu and Cyangugu along the border between DR of Congo and Rwanda. It caused widespread damages and killed at least 39 people. The main earthquake was followed by a large number of aftershocks among which three were of magnitude above 5 and nine were of magnitude above 3.7. Temporary seismic stations deployed in the area recorded more than 700 aftershocks between February 8th and 27th

That seismic episode took place on the Southern shore of Lake Kivu, about 100km South of Goma city and the Nyiragongo volcano. The main shock is of a particular importance because of its shallow depth (more commonly encountered in the Virunga Volcanic Filed to the North) and its unusual high magnitude. It is indeed the largest event ever recorded in the area after the 2002 mb 6.2 earthquake that occurred 35km South West of Goma. That event is also associated to an intense activity of that portion of the East African Rift (EAR). Yet another magnitude 5.3 event struck the area on October 5th 2008, few tenths of kilometers North of Goma. One should go back in 1977 and 2002 (the years of the two only historical eruptions of the Nyiragongo volcano) to find such an intense activity in that part of the EAR.

Unfortunately no local seismic network was operating at the time the main February 2008 event preventing an accurate localization and depth estimate. This information might however be of a great importance for the hazard assessment in the context of a rift tectonic, a region prone to landslides and the presence of a large amount of carbon dioxide and methane gases dissolved in the Lake Kivu.

We show here though how, in the absence of such a local seismic network, ENVISAT and ALOS satellite Radar Interferometry efficiently complemented the teleseismic waveforms studies to accurately infer the source parameters. Geodetic and seismic modeling and inversions lead to highly consistent results. The focal mechanism, strike and dip are consistent with local tectonics.

Moreover the geodetic moment magnitude estimated from InSAR is similar to the moment magnitude estimates from the teleseismic study suggesting that the observed deformation pattern is probably almost entirely co-seismic and related to a brittle rupture with almost no aseismic slip. Despite the unusual shallow depth one can conclude that the Bukavu sequence did not involved magma movement (at least at shallow depth).