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Geophysical insights on the internal dynamics of lahars from Lumbre channel, Volcán de Colima, Mexico

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Here, we present data from lahars through the use of a 3-component broadband seismometer, accelerometer, and a video camera installed 3 m from the Lumbre channel on Volcán de Colima, Mexico to understand rheology differences within multiple events, which occurred in late 2016. We used a combination of peak frequency content, directionality, and video analysis to determine rheology changes amongst the multiple events. Our findings show that different peak frequency patterns in each seismic component correspond to differing rheologies and flow processes. For instance, in the vertical and flow parallel directions the transition from streamflow to lahar coincides with a narrow frequency distribution to wide. Conversely, the cross-channel frequency content is opposite with streamflow portraying a wide frequency distribution transitioning to a narrow distribution with the lahars. Furthermore, there is a drop in overall peak frequencies when transitioning from streamflow to lahar. The directionality ratios computed further yielded evidence for a rheologic change between streamflow and lahar. Directionality ratios >1 were calculated for each lahar, and <1 for streamflow. We go on to show that componential analyses yielded channelization or freedom of movement in the cross-channel, bedload transport in the flow parallel, and channel geology in the vertical direction are possibly the main drivers in the peak frequency output of debris flows.