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Deformation episodes and ash emissions at Nevado del Ruiz volcano, Colombia, from 2009 to 2015

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Ruiz reactivated in 2009 after 8 years of quiescence. During September and October 2010, a gradual increase in seismic activity was observed near the Arenas crater. Deflation was observed in some tiltmeters (up to ?100 rad) and GPS stations (few millimeters) in late 2011, consistent with subsidence caused by the gravitational collapse of the edifice. Inflation began between January and February 2012, and in these months, episodic increases in seismicity were followed by small explosive ash emissions. The number of seismic events increased significantly in March and April 2012 with the release of significant amounts of SO? and ash. Two small explosive eruptions took place in May 29th and June 30th, 2012. Modeling of inflation between 2011 and 2015 pointed to an intrusion (?V = 0.59 km³) that moved from a depth of 7 km b.s.l. (2011-13) to a depth of 3.5 km b.s.l. (?V = 0.006 km³; 2015), located 8 km SW of Ruiz, close to volcano Santa Isabel. In July 2015, the tiltmeter closest to main Arenas crater started to detect a pattern of short inflation/deflation episodes (few days long and up to ?100 rad). Each inflation/deflation episode was followed by significant gas release and ash emissions. Because of the close location of the tiltmeter to the crater, the deformation signal was interpreted as due to the flow of a very shallow mass. The activity of Nevado del Ruiz remained more or less constant - with a record of high seismicity, high inflation rates and intermittent emission of water vapor, gas (SO2) and ashes - until the end of 2015 and the beginning of 2016, when the deformation stopped. A dome forming eruption started in August 2015 and a small dome is now being emplaced in the main crater.