



Formation of Öskjuvatn caldera at Askja, north Iceland: evolution of caldera collapse and implications for the lateral flow hypothesis

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The Öskjuvatn caldera at Askja volcano, north Iceland, was formed as a result of an explosive eruption at Askja on 28th-29th March 1875. Öskjuvatn is one of the youngest collapse calderas on Earth, and its initiation and growth were observed and documented by explorers and geologists working in the Askja region between 1875 and 1932. It is an example of caldera formation where the volume of the caldera collapse far exceeds the volume of associated erupted products. The discrepancy between the collapse volume and associated erupted products has been used by previous workers as a justification for the hypothesis that the injection of lateral dykes from Askja fed the February to October 1875 Nyjahraun fissure eruptions at the Sveinagjá graben, some 60 km north of Askja. However, historical accounts documenting the caldera formation in sufficient detail show clearly that Öskjuvatn formed by piecemeal collapse, taking over 40 years to reach its current form. We use these accounts to undertake a detailed examination of the stages of caldera collapse and to compare this with the known magmatic output of Askja in the years following the 1875 eruption. GIS software was used to calculate the volume of Öskjuvatn during the various stages of collapse, and the volume of material erupted after 1875. While a dyke extending between Askja and Sveinagjá may be implied to account for the 'missing' volume, geochemical evidence indicates that the Nyjahraun magmas were sourced from a deeper reservoir rather than by lateral injection from Askja's shallow crustal magma chamber. We suggest instead that the injection of sills and dykes in an igneous intrusion complex beneath Askja central volcano, combined with background deflation over 30 to 40 years following 1875, satisfactorily accommodates the volume required to form Öskjuvatn caldera.