Numerical modeling of crater lake seepage

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The fate of crater lake waters seeping into the volcanic edifice is poorly constrained. Quantification of the seepage
flux is important in volcanic surveillance as this water loss counterbalances the inflow of hot magmatic fluids into
the lake, and enters the mass balance computation. Uncertainties associated with the estimate of seepage therefore
transfer to the estimate of magmatic degassing and hazard assessment. Moreover, when the often acidic lake brines
disperse into the volcanic edifice, they may lead to acid attack (stress corrosion) and eventually to mechanical
weakening of the volcano flanks, thereby causing an indirect volcanic risk. Understanding of the features that
control the underground propagation of lake waters and their interactions with the magmatic-hydrothermal system
is therefore highly recommended in volcanic hazard assessment. In this work, we use the TOUGH2 geothermal
simulator to investigate crater lake water seepage in different volcanic settings. Modeling is carried out to describe
the evolution of a hydrothermal system open on a hot, pressurized reservoir of dry gas and capped by a volcanic
lake. Numerical simulations investigate the role of lake morphology, system geometry, rock properties, and of the
conditions applied to the lake and to the gas reservoir at depth.