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Watching rocks grow: Theory explains landscape of geothermal springs

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Physicists at the University of Illinois at Urbana-Champaign have successfully modeled the spectacular landscapes seen at geothermal hot springs.

In work reported in *Physical Review Letters* on June 27, physics professor Nigel Goldenfeld and graduate students Pak Yuen Chan and John Veysey present a theoretical model that describes how hot spring water flows over the landscape, depositing calcium-carbonate minerals in the form of travertine. These deposits then dam and divert the water.

"The nonlinear feedback between these two effects inexorably leads to the visually striking landscapes seen throughout the world's hot spring formations," Goldenfeld said. "Remarkably, the resulting geological structures don't depend on the rock structure or the mineral content – the statistical properties of the landscapes can be computed precisely."

The Illinois team was able to analyze such complex landscapes by using novel computational tools that they related to more standard mathematical approaches.

Composed of a nested series of ponds and terraces, hot spring landscapes are not sculpted by the forces of erosion. Instead, the rocks actually grow at a rate of about 1 millimeter per day. The Illinois group's model correctly simulates the way in which the landscape changes over time.

Hot springs comprise a complex ecosystem of interacting microbes, geochemistry and mineralogy. The rapid precipitation of calcium carbonate results in shifting flows, and in the sealing off of some springs and the eruption of new vents.

"Now that we understand the physical processes involved in how these rocks grow, we can address the way in which heat-loving microbes populate and influence the hot springs," Veysey said.

Source: University of Illinois at Urbana-Champaign

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