NS41A-02 A Geophysics Investigation in Geologic Hydrogen: Connecting Surface Features with Subsurface Structures (Invited)

Thursday, 12 December 2024

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146 A (Convention Center)

Abstract

Fairy circles are subcircular surface depression features that are widely distributed all over the world and are commonly considered as a potential indicator of the presence of subsurface geologic hydrogen. However, the relationship between surface fairy circles and subsurface conditions remains unclear. Understanding the relationship between fairy circles and geological structures could assist in understanding potential hydrogen migration pathways and accumulations. We have carried out an integrated geophysical investigation over a group of such circles in the central U.S. that hosts many fairy circles and has elevated concentrations of soil hydrogen coinciding with the edges of the fairy circles. We integrate digital elevation model (DEM), airborne gamma-ray spectrometry (AGRS) data, and ground electrical resistivity data which we collected specifically for this study, to understand the connection between surficial expressions and underlying geology of the fairy circles. DEM data are connected with surface processes such as the soil removal through wind erosion and exposure of underlying layers, while AGRS data image the radioelement concentrations (potassium 40K, equivalent uranium 238U, and equivalent thorium 232Th) directly below the ground surface that are related to the soil and exposed substratum. Meanwhile, the electrical resistivity data image the 3D electrical conductivity variations associated with the subsurface geologic structure connected with the fairy circles. Through integrated analyses of the complementary information provided by these data sets, we can detect variations that reveal characteristics of fairy circles including soil composition, past weathering processes, and subsurface geology. In this presentation, we will first discuss our multiphysics integration methodology. We will then present a geologic model highlighting the characteristics of the fairy circles in the study areas. The model serves to connect the surface expressions of fairy circles to the underlying geology. Our research

provides an initial 3D view into the subsurface geology underlying the fairy circles at this site, and lays a foundation for understanding the hydrogen gas migration and concentration in and around fairy circles, which will ultimately aid in geologic hydrogen exploration.

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