Perchlorate, nitrate, and iodate co-occur in four deserts on Earth

R.A. LYBRAND[1]*, J. BOCKHEIM[2], W. GE[3], R. GRAHAM[4], S. HLOHOWSKYJ[5], G. MICHALSKI[6], J.S. PRELLWITZ[7], J.A. RECH[7], F. WANG[6], AND D.R. PARKER[4]

[1]Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331, USA [*Corespondence: Rebecca.Lybrand@oregonstate.edu]

[2]Department of Soil Science, University of Wisconsin, Madison, WI 53706-1299, USA [bockheim@wisc.edu]

[3]School of Earth Sciences and Resources, China University of Geosciences, Beijing, China [gews@cugb.edu.cn]

[4]Department of Environmental Sciences. University of California, Riverside, CA. 92521, USA [robert.graham@ucr.edu; dparker@ucr.edu]

[5]Department of Geosciences, University of Arizona, Tucson, AZ 85721, USA [stephanh@email.arizona.edu]

[6]Department of Earth and Atmospheric Sciences, Department of Chemistry, Purdue University, West Lafayette, IN, 47907, USA [gmichals@purdue.edu; wangfan@pkusz.edu.cn]

[7]Department of Geology and Environmental Earth Science, Miami University, Oxford, OH 45056, USA [joelwitz@gmail.com; rechja@miamioh.edu]

Our objective was to quantify how perchlorate (ClO_4^-), iodate (IO_3^-), and nitrate (NO_3^-) co-accumulate in the Atacama Desert, Chile; Death Valley, USA; Transantarctic Mountains, Antarctica; and Kumtag Desert, China. We identified environmental controls on soluble salt preservation and examined the role of terrestrial deserts as analogs for Mars. Concentrations of ClO_4^- and IO_3^- were orders of magnitude greater in the Atacama Desert than other deserts whereas NO_3^- concentrations were similar between the Transantarctic Mountains and Atacama Desert. Kumtag Desert exhibited the strongest correlations among the soluble salts. Our findings confirm the critical role of hyper-aridity, geologic age, paleoclimate, and landscape stability in soluble salt preservation and demonstrate that local scale studies of desert soils are required to interpret geochemical relationships on Earth and Mars.