

Geochemistry of mineral resources, human health and environments – a new approach to general education online

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Over the last decade the geosciences have revealed evidence that many of the natural and industrial geochemical components of rocks and minerals may cause adverse effects on human health, eco-water-systems and atmospheric environments. Here we share our experience in designing a virtual laboratory and collaborative projects for the asynchronous online course “Minerals and Human Health”. The course encompasses the significance of the geochemical interactions between earth's mineral resources and people influenced by a variety of natural, human health-related, economic, cultural and political factors. The course takes the students on a virtual field trip to abandoned gold mines in the Mojave Desert, California where our design group extracted samples for geochemical lab analysis from rocks and geothermal hot spring waters. Students are able to observe these samples with images provided from high resolution scanning and transmission electron microscopes and different spectroscopic and geochemical analysis. Advanced recording techniques, including stabilized body cameras, aerial drone footage, macro videography coupled with geochemical analysis and micro-mapping of the distribution of the toxic elements such as Hg, As, Pb, Cd were implemented to give students a simulated geochemical geologist experience.

The virtual laboratory follows as a sequence of interactive videos where students experience surveying and extraction from the field, orientation with lab equipment, and methods for analyzing and identifying mineral particles in dust samples. After learning principle concepts, students put their knowledge into practice in a collaborative project, “The Air we Breathe”. In this project students interact with each other via online discussion forums and video conferencing in order to collect dust particles for lab analysis. Students are astonished to discover that the air they breathe every day includes hazards such as $PM_{0.5-0.2}$ that are classified as carcinogenic materials. Students' projects outline the emissions of hazardous anthropogenic and geochemical contaminants formed during mining and prospecting of the earth's materials, identification of human exposure and health effects, remediation and intervention of the contaminated environments. Join us as we share our lessons learned while creating this extraordinary online learning experience that connects geochemistry to human health and environments.