13th International Symposium on Water-Rock Interaction (WRI-13) Preface

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Preface

The Water–Rock Interaction (WRI) working group of the International Association of GeoChemistry (IAGC) organizes the International Symposium on Water–Rock Interaction on a triennial schedule. Since 1974, in settings varying from Park City (USA) to Vladivostock (Russia), these meetings have focused on scientific research about processes where the interaction of rocks, water in its many forms, gases, life, and human perturbation occur. These symposia bring together scientists, engineers, professionals, and students from around the world that represent almost all the Earth science disciplines, including geology, geochemistry, petroleum geology, ore deposits, environmental sciences and hazard geology.

The 13th Water–Rock Interaction meeting (WRI-13) was held from August 16 to 20, 2010, in Guanajuato, Mexico. WRI-13 continued the practice of past meetings of bringing together diverse specialists presenting high-quality studies and promoting scientific discussion and collaboration in an open and friendly atmosphere. WRI-13 was organized into 16 different sessions, which ranged from high-temperature reservoirs to low-temperature systems, geochemical processes in isotopic studies, water–rock interaction in magmatic systems, ore forming processes, groundwater quality and environmental geochemistry, sequestration of CO₂, geological hazards and biogeochemical processes, among many others. Scientists, engineers, professionals, and students from 35 countries presented 231 manuscripts, which after a comprehensive review process were included in the meeting proceedings volume (Birkle and Torres-Alvarado, 2010). In particular, WRI-13 recognized the important scientific contributions of Hitoshi Sakai, with a special session conducted in his honor entitled Measurements and applications of stable and radiogenic isotopes and other tracers. This Special Issue of Applied Geochemistry features selected papers from the WRI13 Symposium, covering almost all meeting sessions, that document the broad spectrum of topics normally included in the WRI meetings. For convenience, papers in this special issue are organized following the conference sessions as follows:

1. Hitoshi Sakai memorial session: Measurements and applications of stable and radiogenic isotopes and other tracers

This memorial for Hitoshi Sakai, written by his second son Ken Sakai, commemorates the extended and multi-faceted career of Hitoshi. It presents a detailed narrative of his professional career and his major scientific contributions, comprising the publication of more than 167 research papers and the textbooks Stable Isotope Geochemistry (Sakai and Matsuhisa, 1996) and The Origin of Earth and Life (Sakai, 1999).

W.G. Darling et al. review the potential applications of the trace gases chlorofluorocarbons (CFCs) and sulphur hexafluoride (SF₆) as useful and inexpensive dating methods to constrain a variety of groundwater problems, such as tracing flowlines, detecting small modern inputs in ‘old’ waters, and pollution risk assessment.

Environmental isotopes (particularly δ¹⁸O, δ³³H, and δ¹³C values, ⁸⁷Sr/⁸⁶Sr ratios, and δ¹⁴C) were applied by I. Cartwright et al. to constrain geochemical processes, recharge distribution and rates, and inter-aquifer mixing in the Riverine Province of the southern Murray Basin, Australia. Water constitutes a finite resource in the region, as recharge rates are low and groundwater is several thousand years old.

E. Nakata and collaborators performed a series of C isotopes measurements in gas samples obtained from well cores in the South Kantō gas-field around Tokyo Bay. Based mainly on the ¹³C isotopic composition of the gas samples, they note a relationship between ¹³C-rich CH₄ with regional faults, gas and water mixing processes, deducing the origin and evolution of the gas from the Tokyo Bay area.

2. Advances in numerical modeling of water–rock interaction processes

R.J. Perez et al. present a software package for modeling geochemical interactions between water–rock–gas or water–rock–gas–petroleum. Based on fluid phase equilibrium concepts, electrolyte theory, and solid–liquid equilibrium theory, they show that their program might be useful for modeling enhanced oil recovery or CO₂ sequestration in oil reservoirs.

3. Characterization of mineral surfaces and water/mineral interfacial processes

K. Pachana et al. evaluate the chemical and mineralogical changes in the biotite and muscovite basal surface after interaction with acid fluids of different pH and at different temperatures. They found a relationship of mineral dissolution and precipitation at a nanometer scale with surface patterns, pH values and temperature.

4. Environmental geochemistry

Based on dated sediment cores, A.M. Hansen compares the historical accumulation of metals in some Mexican lakes and water reservoirs. She records the degree of anthropogenic influence in these lakes in Mexico mainly considering Pb, Hg, As, Ni, Zn and Cr, demonstrating the importance of an extensive sediment sampling program for detecting historical trends in contaminants and for distinguishing pristine from polluted regions.

5. Geological hazards related to water–rock interaction

A.V. Kiryukhin et al. describe the formation of the hydrothermal system in Geyser Valley (Kronotsky Nature Reserve, Kamchatka) as part of a partially melted magmatic body, recharged by meteoric water along outcrops of rhyolite-dacite extrusions and affected by fast erosion rates. The inclination of the sliding plane towards the
Geysernaya river basin, a pressure increase in the fluid-magma system, hanging block saturation by water during spring flooding, hydrothermal alteration weakening of the sliding plane, and steam explosions are presented as potential triggers for the Giant Landslide from June 3, 2007.

The potential health hazard from human exposure to natural degassing of CO₂ and H₂S gas in cold gas emission zones on the flanks of the Colli Albani volcano (Italy) was evaluated by a geochemical study from M.L. Carapezza et al. The authors concluded a relevant hazard for both gases in the depressed zones (channels, excavations), particularly in the non-windy early hours of the day.

6. Significance of water-rock interaction for reconnaissance and remediation of contaminated sites

A. Villalobos-Aragón et al. investigated Cr, major ion and trace element concentrations and Cr stable isotope data of groundwater in a heavily contaminated aquifer in the Buenavista area of the Leon Valley in central Mexico over an area where Cr ore processing residue piles from a chromite production factory are the main source of Cr in the environment. The aquifer directly beneath the factory has strongly elevated Cr(VI) concentrations and Cr-isotope data exhibit only a small increase in 53Cr, indicating a minimal reduction of Cr(VI) to Cr(III) and suggesting that the high Cr(VI) concentrations have overwhelmed natural reductants in the aquifer. The fringes of the Cr plume have substantially lower concentrations that are explained by transport of the main plume or mixing between waters from a nearby landfill and the highly Cr-contaminated waters.

7. Water–rock interaction controlling groundwater quality

R. Cidu and collaborators report the chemical characterization of soil, stream sediment, fine-grained ore-processing waste, surface water and groundwater from the Rio Mannu basin near Narcao (SW Sardinia, Italy), where several Pb–Zn mines are now abandoned and represent a contamination source for the region. Besides the contamination potential of the materials, they conclude that an extensive characterization plan may represent a relatively inexpensive tool for establishing mitigation actions, prior to the realization of a complete, and usually expensive, remediation project at abandoned mine sites.

8. Water–rock interactions in biogeochemical processes and genesis of petroleum

A. Möller and A.M. Hansen have developed and validated a zero-dimensional model to predict the environmental fate of ethylenethiourea (ETU) in soils. Based on assumptions of the dominant process mechanisms, kinetic submodels for sorption, photodegradation, abiotic oxidation and biodegradation were developed and tested with data from literature.

D. Medas et al. investigate the variables controlling the biomineralization process and variation of the hydrochemical factors affecting hydrozincite precipitation, looking at the application of hydrozincite as a natural remover of harmful metals from stream waters. They characterize the optimum hydraulic settings and seasonal variations for hydrozincite formation, helping to assess the best conditions to develop future bioremediation techniques.

9. Water–rock interactions in geothermal systems

A hydrogeological and geochemical assessment study is presented by Z. Pang et al. to evaluate the potential of the Neogene Guantao formation in the Bohai Bay Basin (Northern China) for CO₂ sequestration. Overall, enhanced porosity and permeability conditions of the host formation, a high CO₂ solubility by low salinity groundwater, extended residence times for groundwater, low to medium temperature conditions, and pressure ranges offer favorable conditions for a CO₂ sequestration pilot test with an estimated CO₂ storage capacity of 17.03 Mt for the Guantao formation.

Based on geochemical and geophysical studies, E.P. Bessonova et al. studied the water–rock interaction processes, as well as the inner structure of boiling mud pools at the Mutnovsky volcano, Kamchatka. This combination of methodologies allowed recognition that the vertical structure of the feed channels, along with their complex geochemical zonation, lead to a high contrast in the chemical composition of the mud solutions.

10. Water–rock interactions in mine tailings

F. Frau et al. investigated short-term changes in water chemistry, associated with diel cycles during base-flow conditions at a sampling station on the Baccu Locci stream, draining an old mine area in Sardinia (Italy). Adsorption/desorption of/from streambed material is believed to be the main in-stream mechanism causing variations in dissolved concentrations of As and Zn. A normalization method for data from asynchronous sampling has been developed and proposed to eliminate, or at least attenuate, the effect of sampling time and provide an additional tool to identify the processes/mechanisms involved in trace element concentration fluctuations along a contaminated stream.

11. Water–rock interactions in watersheds

P. Krám et al. examined the effects of lithology on streamwater chemistry in three comparable watersheds in the Czech Republic in central Europe underlain by contrasting silicate lithology over the course of a decade from 2001 to 2010. The three watersheds have similar altitude, area, topography, mean annual air temperature, and atmospheric deposition fluxes but their aquatic chemistry is distinctly different, closely reflecting the composition of the underlying bedrock.

Finally, the guest editors would like to express their gratitude to the authors and numerous reviewers for their outstanding efforts in preparing their manuscripts and evaluating the papers, making the publication of this Special Issue possible.

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