

Editorial

A tribute to Pedro Rivas

The collection of research papers included in these two issues of the *Journal of Iberian Geology* is a tribute to Pedro Rivas, a geologist of exceptional merit, with a remarkable and productive scientific career. Almost all the papers in this issue deal with the high radioactive waste disposal to which Pedro dedicated the last part of his professional life.

But let's start from the beginning. Pedro joined the *Junta de Energía Nuclear* in Madrid (later known as CIE-MAT) in 1961 and his earliest professional work consisted in the uranium prospecting in southwestern Spain. He participated in the sampling of uranium minerals from mines, boreholes and mine tailings. These activities gave him a valuable experience on the work to be done from the very first steps. After a few years, he was transferred to the mother house in Madrid to the Mineralogical Laboratory, under Dr. Enrique Mingarro leadership.

He soon became Dr. Mingarro's right hand and took charge of the Laboratory when the former retired. A few years before, the importance of the management of the high level radioactive wastes (HLRW) and their disposal underground became very clear and some scientific research groups, among which was the Mineralogical Laboratory group, started the studies on the burial of the HLRW in Spain with the sponsorship of ENRESA, the Spanish agency for the management of the radioactive residues.

Pedro performed the planning, coordination, scientific and technical management of many projects supported by ENRESA and the European Commission (EC). But maybe, the project that brought him more satisfaction was the El Berrocal project. The El Berrocal site was the first place where the Spanish investigations started back in 1989. El Berrocal is a former U mine and though it was not economically profitable anymore, it was very helpful

to start understanding the migration of radioactive contaminants in a granitic and low permeable medium and to begin testing a series of methodology and technology. Thanks to El Berrocal, the group led by Pedro, which was now called Hydrogeochemical Characterization Site, became one of the first Spanish scientific groups involved in the deep geological repository research.

El Berrocal project led to many other projects, financed by ENRESA and/or the EC, on the deep burial of HLRW both in granites and in clay formations. The projects involved issues as mineralogical and physico-chemical characterization of the clay material used in the engineered barriers, as well as its hydraulic, mechanical and thermal properties; geochemical processes and water-rock interaction expected in a repository and their application to the performance assessment; role of the colloids on the transport of radionuclides; sorption mechanisms and migration of radionuclides towards the geosphere, providing new data to the thermodynamic data bases of relevant radionuclides; and studies of natural analogues.

Pedro's profound dedication to the general progress of radioactive waste disposal in Spain led him naturally to assume an increasingly heavy administrative burden in addition to his own research. In his quest for fostering innovative science, he established strong links with universities and private and state companies both in Spain and abroad.

Despite the demands on his time from such organizational involvements, he was able to maintain an impressive pace of creative research. Pedro directly participated in the design of various prototypes, such as the Hydrogeochemical Mobile Unit, Ciemat's data loggers, equipment for the hydraulic characterization of low permeable formations and a mock-up to simulate a disposal gallery of HLRW. He also coordinated the development

of these projects and supervised their functioning in the field: The Hydrogeochemical Mobile Unit is, up to this date, the only mobile unit in Spain for in situ sampling of underground water from 600 m in depth under anoxic conditions. The main aim of the mock-up experiment is to simulate the behavior of the clay barrier subjected to heat, water flow and mechanical stress. It has been considered as a reference experiment in Europe and led to build a similar one at Mol (Belgium), according to the Belgian deep disposal concept, and another simulation under real conditions in Grimsel (Switzerland). He also contributed to the creation of specialized laboratories, as the laboratory of migration, sorption and colloids, the laboratory of thermo-hydro-mechanical characterization of clays or the laboratory of porewater geochemistry. The expertise of the group lead by Pedro can also be applied to other environmental fields, such as restoration of uranium mines and in situ continuous surveillance of contaminants in water.

The development of the laboratory has remained an ongoing process because of Pedro's insistence on remaining on the cutting edge of the deep geological repository research and because of the numerous technological advancements in the field over the past 15 years.

The hallmarks of Pedro's career have been his innovation, thoroughness, a keen sense of the state of the art, which enables him to key into the areas for most fruitful research, and above all, his generosity. His lab has served

as a scientific "nest" for many of the modern ideas on the disposal of HLRW, and it has always been open to a stream of graduate students, eager to obtain their PhD degree, and visiting researchers from around the world.

Along the development of these activities, Pedro did promote working in teams as well as the resolution of problems focused from a multi-disciplinary point of view but not forgetting the final aims pursued.

The training of research teams in hydrogeochemistry, radionuclide migration and geochemical processes in granite and clays has contributed in a decisive way to the fact that, nowadays, the radioactive waste management has more technological, methodological and human capacities that allow to see the future with confidence and optimism, because those groups continue most of the research lines pointed out by Pedro Rivas, our excellent researcher, promoter and manager.

With the collection of papers herein presented, we congratulate Pedro on more than 30 years of major scientific contributions. He is undoubtedly one of the few persons in our scientific community with a global vision of the problems that a deep geological repository poses, which enables him to know what has to be the future policy of the management of the HLRW, regardless of what the politicians might favor.

With his retirement, his colleagues have lost a great researcher and a generous person, but his family has gained an excellent husband and father.

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