



The Clay Minerals Society

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THE PRESIDENT'S CORNER



Douglas K. McCarty

As this is my last column, I must thank all the members of The Clay Minerals Society for giving me the opportunity to serve as president. This is a great honor, which I do not take for granted. This year has been a humbling and educational experience. I extend thanks to all the people who have served CMS as committee chairs, committee members, councilors, officers, and office staff: you are the heart of the society. To close out my term, I would like to further make a case for the value of clay science research from natural environments.

In my first President's Corner (*Elements*, v13n4, p 282), I discussed the increasing number of published materials science clay studies and the decreasing natural science publications. In my last column (*Elements*, April 2018, v14n2, p 127), I included an excerpt from a 1989 *CMS Newsletter* interview with the late Professor Robert C. Reynolds Jr., where in discussing the trends in our (natural science) field he said, "there is a renaissance in materials science", which is driven by the economics of metal films such as semiconductors that are intercalated compounds analogous to mixed-layered clay minerals. In 1967, Reynolds published the first calculation of a full X-ray diffraction profile from a mixed-layered clay, illite-smectite. At the same time, Professor Victor A. Drits, Head of the Laboratory of Physical Methods for Investigating Rock Forming Minerals at the Geological Institute of the Russian Academy of Science in Moscow, developed a sophisticated computer program to calculate diffraction patterns from mixed-layered clay systems and from a wide variety of intercalated lamellar compounds. Reynolds was a geologist whose work evolved into materials science, and Drits is a physicist whose enormous body of work made significant contributions to the structure, composition, origin, and evolution of clay minerals in natural systems.

Professor Drits was interviewed by CMS for the February 1992 *CMS Newsletter*. The following is an abbreviated excerpt from his response, which I think provides insight into the relationship between the natural and materials science fields.

CMS: [H]ow did your personal research interests develop over the years?

Drits: [B]eing a part of the Geological Institute, we were always collaborating with geologists. My interests were in two directions. The first is developing methodological approaches to interpreting diffraction and spectroscopy data obtained from fine-disperse minerals. The second is solving crystal structures, the more exotic and complicated the more challenging, both clay and non-clay.

CMS: You've mentioned your cooperation with the geologists at your institution. In which directions did this cooperation develop?

Drits: For the thirty years that I've been working at the institute, I've been constantly participating in studying diverse geological objects and processes. The main problems in our cooperation were associated with revealing interrelationships between fine structural peculiarities, composition, and formation conditions of minerals in various geological environments; in elucidating mechanisms for structural transformations of minerals; in searching for regularities in the distribution of clay minerals in continents, transition continental-marine zones, in marine sediments and basalts, and so on.

We described, in terms of the solid-phase transformation, illitization, and development of ordered mixed-layer illite/smectite in the course of diagenesis from bentonites of Karaganda basin (Republic

of Kazakhstan). Using the density-gradient technique, we could quantitatively evaluate the degree of heterogeneity in glauconites differing in age and rock type in order to solve the problem of their formation conditions.

In the early sixties, we studied the transformation history of biotite and muscovite at different decomposition stages and in different geological environments. We believed that the existence of these main micas of crystal rocks in the sedimentary cycle would clarify the genesis of sedimentary clay minerals. We showed that in humid diagenesis-epigenesis, illitization of detrital flakes of biotite accompanies chloritization. A study of muscovite flakes differing in density, found in weathering crusts, indicated that kaolinization proceeds without any appreciable intermediate phases, through dissolution-precipitation. Studying the crystal-chemical features of clay minerals formed under different facies and climatic conditions, we concluded that both under low pH typical for coal-bearing complexes and under high pH and high mineralization of solutions typical for evaporite basins, authigenic clay formation often proceeds through synthesis and is hardly affected by the initial composition of the detrital mud. Some of these results were summarized in English in the special volume of *Sedimentology* published in 1970.

When we got samples from the first two expeditions of *Glomar Challenger*, we studied smectite from the Atlantic sediments and found them to be relatively Fe-rich in composition and lath-shaped. We concluded that they were authigenic products of basalt alteration. Comparing dioctahedral smectites derived from basalts and ultrabasic rocks of continental versus marine origin, we found a pronounced, though still puzzling, difference in the exchange cations: Ca = Na on land and K in the sea. Remarkably, the paragenesis of authigenic smectite was found to be characteristic only of pelagic clays.

The interview with Professor Drits continued in his precise and charming style, describing in detail many other discoveries about clay minerals and their origin and evolution in natural environments. The body of work by Professor Drits and his colleagues stands alone in both rigorous structural analysis and the relationship to geological environment. While clay studies related to materials science seems to have a stable future, the decreasing interest and support for clay studies in the natural world is a concern. Without the high quality of research in natural systems by scientists like Drits, Reynolds and others, clay work in material science would be less productive where physical properties are controlled by structure and composition.

Quality clay science research in natural systems deserves academic support, which I am sure would make positive feedback in the practical problems of fine disperse materials.

CITED REFERENCE

Reynolds RC Jr (1967) Interstratified clay systems: calculation of the total one-dimensional diffraction function. *American Mineralogist* 52: 661-672

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