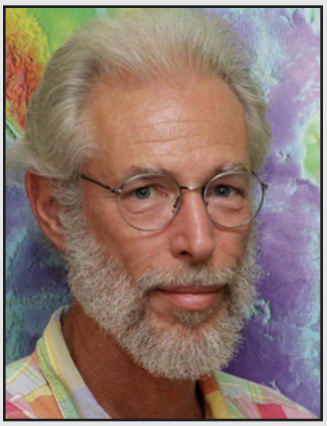
STRUCTURAL GEOLOGY & TECTONICS DIVISION CAREER CONTRIBUTION AWARD

Presented to Paul F. Hoffman



Paul F. Hoffman
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Citation by Samuel A. Bowring

Paul Hoffman has profoundly changed our understanding of earth history by integrating and synthesizing geological observations, tectonics, geochemistry, and climate science. Many here may be most familiar with Paul's most recent work on Neoproterozoic climate history, often simplified as "Snowball Earth" and not his first twenty-five years of work on the origin and development of continental lithosphere. However, what may appear at first glance to be a two-part history is rather a continuum in which Paul's natural curiosity and strongly integrative approach melded to provide a better understanding of how our planet operates.

Paul Hoffman is without doubt one of the most influential and creative geologists of the past 100 years and it is an honor to present him for the 2009 Structural Geology and Tectonics Division Career Contribution Award. It is no coincidence that seventeen years ago Paul received the Division's Best Paper Award for his paper entitled "United Plates of America, the birth of a craton: early Proterozoic assembly and growth of Laurentia."

This contribution, known to most as the "United Plates" paper is probably the most influential paper for the study of Precambrian continental lithospheric evolution in the past two decades and was borne of more than twenty field seasons in the Canadian Arctic followed by five years of intense office work examining maps and reports and drafting maps and figures. During his Ph.D. studies and early years at the Geological Survey of Canada, Paul recognized that the plate tectonic models being applied to the Appalachians could easily be adapted to Proterozoic rocks of the Canadian Shield. He built upon the careful, measurement-intensive work in the east arm of Great Slave Lake to develop plate tectonic models for basin development, from subsidence to deformation. Central to Paul's approach when trying to understand plate tectonics was the recognition that huge reservoirs of information — from paleocurrents to infer changing topography and provenance in a tectonically controlled basin to recognizing the role of precipitation in driving uplift — are contained in sedimentary rocks.

This was followed by a now legendary effort at understanding the history of Wopmay orogen. The team of students, co-workers, and colleagues that Paul led during the mapping of Wopmay orogen was independent, diverse, and expert in a broad cross section of disciplines. At the core of compilation maps for this part of the Canadian Shield are many years of 1:50,000-scale mapping. Paul has a voracious appetite for knowledge and made sure that he and his team had a deep understanding of plate tectonics on the present day earth from the development of passive margins, thrust and fold belts, foreland basins, and magmatic arcs to the chemistry of arc magmas and the utility of geochronology and isotope geochemistry so that they could apply it to their rocks. Wopmay orogen is now one of many, but probably the best studied, Paleoproterozoic orogenic belts that provide evidence that plate tectonics operated at least 2.0 billion years ago. The lessons learned in Wopmay orogen and the recognition of the power of synthesis led Paul to expand his approach to the entire Canadian Shield, Laurentia, and the history of supercontinents. It is impossible to overstate the influence that Paul has had as his approach has served as a template for analysis of other continents and for intercratonic correlations.

Following his Laurentian synthesis, Paul began the second phase of his career, applying the tools of field mapping, structural geology, section measuring,isotope geochemistry, geochronology, and plate reconstructions to understand Neoproterozoic earth history. Paul first went to Namibia to develop a tectonic story of Pan African orogens and the amalgamation of Gondwana, but what piqued his interest was the juxtaposition of glacial deposits with platformal carbonates. Most geologists would not be broad or creative or even interested enough to notice such a juxtaposition, let alone want to completely change their research agenda and study it in detail. However, this is a perfect example of Paul's breadth and creativity. Within two years, and based on detailed observation rather than conjecture, he was to develop the Snowball earth hypothesis to a level of detail way beyond Kirschvink's original hypothesis. He immersed himself in the literature of low-temperature stable isotopes, paleooceanography, and glaciology, and built a comprehensive, multidisciplinary hypothesis that helped lead to a series of landmark papers and perhaps more importantly, a new generation of scientists who can integrate tectonics, climate science, biology, and geology. One has to wonder how many classically trained geologists 10-15 years from retirement could "switch gears"and have such an impact?

Many of us in the room have argued with Paul on topics that range from a sedimentary structure in a rock to politics, track and field, jazz, and baseball and know that such discussions are not for the faint of heart or the unprepared. His encyclopedic knowledge and photographic memory have left many stuttering and speechless and/or infuriated. On the other hand, Paul has been a generous mentor for students and colleagues and in any endeavor, whether physical or intellectual, leads by example.

Paul Hoffman has had a profound influence on our understanding of the importance of plate tectonics in earth history, from the construction of continental lithosphere and supercontinents to the chemistry of Neoproterozoic oceans and atmospheres and richly deserves the GSA Career Contribution Award.

Response by Paul F. Hoffman

Thank you, Sam, for the generous citation. Recognition by one's peers is second only to the kick one gets from the work itself.

When I look back, I see that many of my interpretations were failures. Most of those that didn't fail, weren't original. My first paper appeared in *Science* over 40 years

ago. It showed that stromatolite shape and orientation give the direction and facing of ancient shorelines. I subsequently found that the eminent paleontologist Winifred Goldring of the New York State Museum had reached the same conclusion three decades earlier.

I was first known in tectonics circles for the concept of *aulacogens*, the failed arms of rift systems that opened to make ocean basins. I knew and acknowledged their recognition by Nikolai Shatsky in Russia in the 1940s, and their interpretation based on studies in Africa by Hans Cloos and Kevin Burke. The problem was, my own example in the east arm of Great Slave Lake wasn't an aulacogen at all, it was a collision zone between the Slave and Rae cratons.

In the Wopmay orogen of northern Canada, I had recognized a rifted continental margin 1500 km inland from the present Pacific margin: either the continent had grown by accretion of juvenile crust, or continental rafts had been added by collisional orogeny. At the time, 1970-71 and years before Cordilleran suspect terranes, I thought a Precambrian continental margin was news. I didn't know that 20 years earlier, long before plate tectonics, the first pre-Mesozoic continental margin had been recognized in the Adelaidean (Neoproterozoic) of South Australia. Its discoverer was the far-sighted geologist, entrepreneur and conservationist, Reg Sprigg.

The age of initial rifting in Wopmay orogen and the location of the collisional geosuture between the deformed passive-margin and accreted terrane were high on my research agenda. Sam Bowring later showed that rifting occurred 115 Myr earlier and the passive-margin stage lasted seven times longer than we initially inferred. Robert Hildebrand forced the geosuture to retreat tens of kilometers toward the craton, cutting anchor from the intervening terrane. Message to Cordilleran geologists about Hildebrand: do not be too quick to dismiss GSA Special Paper 457!

My thoughts on supercontinents, sea-level and climate were anticipated by Tom Worsley and my reconstruction of paleo-northern Rodinia was derived from Charlie Jefferson. Where we had placed Australia-Antarctica, Jim Sears elbowed in Siberia and Zheng-Xiang Li inserted South China. Around this time I gave a talk at Queen's University in Ontario on, "The value of making BIG mistakes". Afterwards, an earnest undergraduate asked, "If you acknowledge making mistakes, won't people stop believing you?" Evidently my talk had failed as badly as my geology.

Which brings us to Snowball Earth. I used to be labelled a "doctrinaire uniformitarian" for saying that plate tectonics has changed little since the Mesoarchean, 3.5 billion years ago. That criticism, at least, has ceased! Some people think I've gone the way of Sam Carey, the great Tasmanian structural geologist, glacial sedimentologist, global tectonicist and academic administrator, who is sadly remembered most for his unshakeable adherence late in life to the expanding Earth hypothesis. There is nothing more pathetic than a scientist who clings to a false theory too long, but there is nothing worse for science than one who gives up on a good idea too soon. This is the tight-rope I chose to walk. As of now, I'm sticking with the snowball hypothesis. Of course, the concept has changed some over the years. Tropical marine platforms like the one I study in Namibia were not just enveloped by sea ice, as I originally envisioned, they had their own dynamic ice sheets, complete with ice streams. But the core idea of an ocean-wide dynamic ice-shelf still best explains the ocurrence of iron-formations, cap carbonates and extraordinary CO_2 levels inferred from boron, carbon, oxygen and calcium isotopes.

Finally, it is customary for Career Awardees to proffer some "sage" advice. With the recent history of large lending institutions and my own failures in mind, I give you this. Beware of science projects that are "too big to fail." Paraphrasing the philosopher Karl Popper, What can't fail, isn't science.

Thank you, and let us vow to keep the makers of field boots in business.