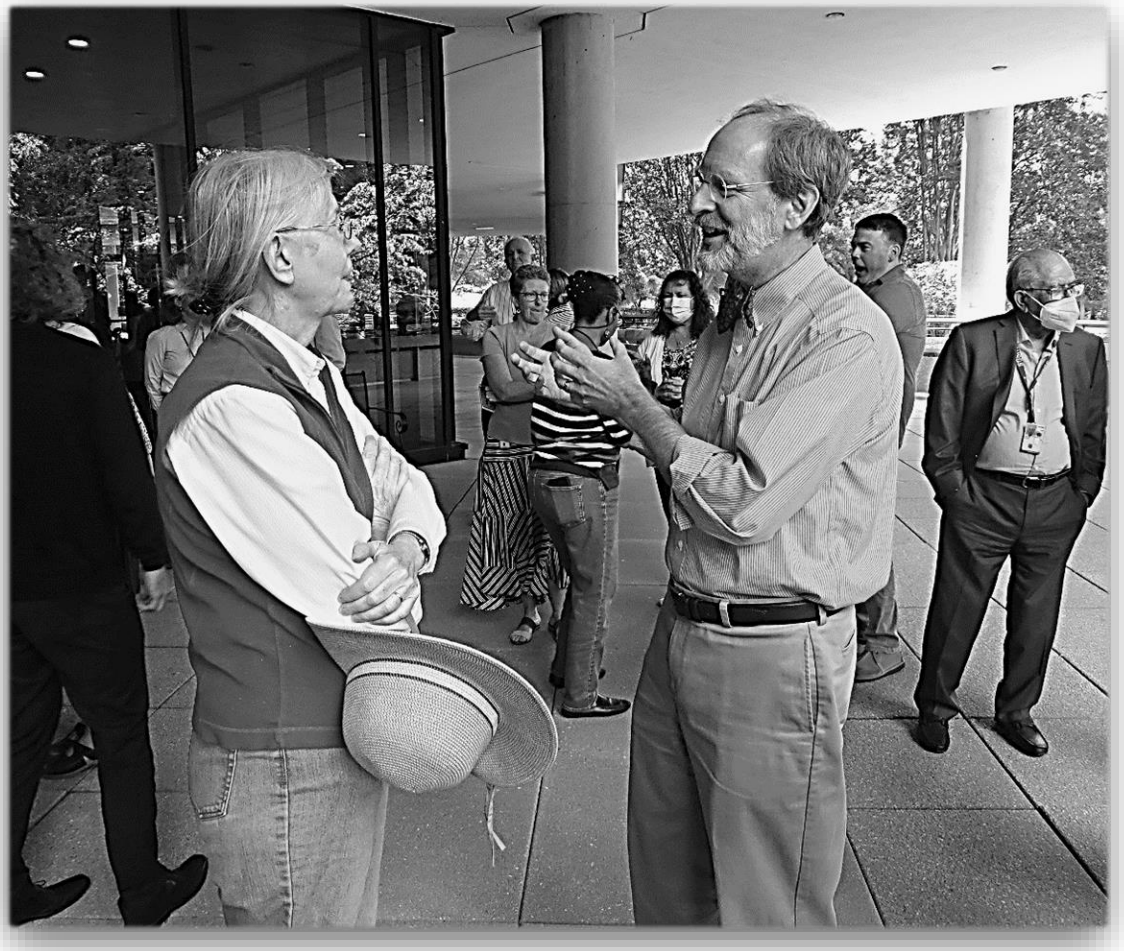
U.S. Geological Survey

The Geologic Division Retirees Newsletter



The 18th Director of the U.S. Geological Survey

Number 83 **Fall, 2022**

An organization of retirees of the Geologic Division, U.S. Geological Survey, who seek to keep in touch with each other and with their former Agency.

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About the Cover:

Dave Applegate, 18th Director, with Kathleen Gohn at the Meet-the-Director Gathering, Reston, Sept. 27, 2022. In right background, with mask, is Said Mirzad, International Programs, who, at age 92, is the oldest Survey member still on the rolls.

From the President

As 2023 approaches, I have a sense of "the world" returning to normal at the USGS National Center in Reston. There are lots of cars in the close-in parking lots. Many staff members of the energy and mineral resources team and the geologic mapping and climate team are in the office. The Reston-area retirees have begun meeting for a monthly brown bag lunch in the rooms adjacent to the cafeteria.

David Applegate is off and running as the 18th Director. He was confirmed by the Senate on August 4, 2022. As Associate Director for Geologic Hazards since 2004, Dave is from within the Survey, unlike most of the previous Directors since 1994. Counting Clarence King as, of necessity, from the outside, from 1881 to 1994, all Directors except Bill Wrather and Bill Menard were those who rose up through the ranks to receive their appointment. For most of that time, Directors did not change with changes in the political party in power. The average tenure was a bit more than 11 years for each of them. This was a tremendous advantage for long-term program management, as each person had time to plan and carry out science strategies. George Otis Smith had the longest tenure, from 1907 to 1930. Since 1994, we have had seven Directors, and each was appointed as a result of a change in Federal administration in the White House.

Please share with us how you are faring in this new normal world. Are scientists emeritus spending more time in the office at other centers? Are you getting together with former USGS colleagues? Send your stories to me at r2susan53@gmail.com for the Spring 2023 newsletter.

Cheers,
Susan Russell-Robinson

From Director Dave Applegate

(Dave came to the USGS in 2004 as head of the geologic hazards program. He earned a B.S. from Yale and a Ph.D. from MIT, both in geology. He taught at Johns Hopkins and the University of Utah, served as a Congressional Science Fellow for the Senate Committee on Energy and Natural Resources, and then spent 8 years as director of science policy at the American Geologic Institute before joining the USGS. The following account was written by Dave for the National Association of Geology Teachers magazine in 2016. It serves as a good introduction to Dave and his career for those who don't know him.—Editor)

I spent the summer of 1989 working for the U.S. Geological Survey in Golden, Colorado, on an NAGT/USGS Summer Field Camp Fellowship, for which I remain profoundly grateful to both NAGT and the USGS. Getting to Golden was made possible by a wonderful field camp experience the previous summer, when I was one of about a dozen rising juniors and seniors learning the ropes under the guidance of Bill Travers from Cornell. The first half of this field camp was in the Hoback Range of Wyoming, where we operated out of the University of Michigan geology department's collection of aluminum-roofed cabins nestled in a remote valley. I reached it by way of a 48-hour bus trip from Seattle to Jackson and then by hitch-hiking the rest of the way. Being of the generation that came to geology through the writings of John McPhee, the highlight of those first few weeks was a day's field trip through Jackson Hole with J. David Love, the USGS geologist who was the subject of McPhee's *Rising from the Plains*. For the second half of camp, we were thrown into mapping the hanging-wall and footwall of a metamorphic core complex in the Pioneer Mountains of Idaho. Unlike the well-trod exercise in the Hobacks, where generations of field-camp students had mapped the same locations, and the professors were armed with an answer key, Travers did not know the Pioneers any better than we did. That shared learning experience was far more representative of what research would be like and far more rewarding, stumbles and all. After camp was over, I re-boarded a Greyhound bus back to Seattle to spend the month of August trying out my new-found skills in the Olympic

Mountains, mapping basalt slices in an accretionary complex for my senior thesis.

That was pretty much the sum total of field experience that I brought with me to Golden to serve as a field assistant for the USGS geologic mappers. The veteran field geologists for whom I was working—Ernie Anderson, Mike Machette, and Alan Nelson—were welcoming but clearly quite frustrated to be office-bound that summer as field work had been cancelled due to tight budgets. While it pained my mentors not to be traipsing around mountains, I was delighted to be spending the summer in Colorado. Having lived my life as an easterner, the glamour of being at the foot of the Front Range was considerable. I shared a little house on a ranch outside of town with two Colorado School of Mines (CSM) students who worked for the USGS. I would ride my bike to the USGS office on the Mines campus every day, passing the giant Coors factory that still dominates the town and fills the air with the pungent scent of fermenting hops. Weekends were given over to exploring the high country in pursuit of 14,000-foot summits.

One of my main projects that summer was transferring detailed measurements that Ernie had made on airphotos in the field to a topographic map base. This involved spending many hours at a giant mechanical photogrammetric plotter—a large, gangly contraption that made it possible to see the photos pop out in three dimensions. As one moved over the images, its spider-like arms traced those movements onto the topo maps. I would follow geologic contacts as I took virtual flight over the canyons and ridges of southern Nevada.

I used the same machine for Alan, tracing profiles across the tectonically uplifted beach terraces on Isla Mocha off the coast of Chile (and just south of the rupture zone for the magnitude-8.8 earthquake that struck Chile earlier this year). A full-time technician was required to laboriously set up the machine so that the stereo photo pairs were synchronized with the map. This wonder of precision optics has largely (but not entirely) been replaced by computer graphics in the digital era. The time spent poring over that terrain, however, was well spent, and the skills of careful geologic investigation are quite transferrable to a digital medium.

For his part, Mike sent me to the USGS library in the Denver Federal Center, where I did literature searches and compiled annotated bibliographies for the glacial and tectonic history of the Puget Sound lowlands and other areas. I enjoyed the serendipitous explorations that such a library afforded, following citations where they led down multiple paths (and the occasional intellectual gopher hole). I was a one-man Google search engine, blissfully unaware of my own looming obsolescence.

Throughout these projects, all three mentors were wonderful guides who made the effort to give context to these tasks and involve me in the broader scope of their research. At the end of that Golden summer, I headed to grad school with a much better sense of the work of a professional geologist and with a profound respect for the dedication and acumen of the men and women of the USGS. It took me 15 years to make it back to the USGS, where I coordinate geologic hazards activities. One of the two principal centers that my programs fund is the Geologic Hazards Science Center, the current incarnation of the branch where I worked that summer on the CSM campus. Down the hall from my old cubicle are the scientists who generate the National Seismic Hazard Maps that form the basis for seismic provisions in building codes that lie at the core of mitigating the toll of earthquakes. A floor above is the National Earthquake Information Center, a 24/7 operation monitoring and reporting on global earthquake activity. A floor below, the landslide group operates a debris-flow warning system in southern California, and the geomagnetism group maintains over a dozen observatories throughout the U.S. and its territories, tracking fluctuations in the Earth's magnetic field and perturbations caused by solar storms.

Ernie had retired and Mike's retirement was imminent when I returned to Golden in 2004 shortly after joining the USGS again. Alan Nelson was still there and indeed is still going strong, undertaking paleoseismic studies that are changing our understanding of the earthquake hazard in the Pacific Northwest and elsewhere. On that first trip back, I was asked to speak at an all-hands meeting, where I told the story of running into Ernie and Mike a few years earlier at a Geological Society of America meeting, where

they greeted me warmly and said that they had just been talking about me. It turned out that the USGS library had contacted them about a book checked out to one of them some years back, and they thought, hey, maybe that Applegate kid had it. Alas, it was not one that I had used, but it was sure great to be remembered!

Directors and Their Tenure

(As a useful review, I compiled a list of our Directors and their time in office. The gaps represent times when no Director had been appointed, and we had Acting Directors. Three actors who spent significant time in that role over the last 25 years were Tom Casadevall, Bob Hirsch, and Suzette Kimball. For the recent appointees, I added the months to be more precise about their tenures.—Editor)

Clarence King, 1879–1881
John Wesley Powell, 1881–1994
Charles Walcott, 1994–1907
George Otis Smith, 1907–1930
Walter Mendenhall, 1930–1943
William Wrather, 1943–1956
Thomas Nolan, 1956–1965
William Pecora, 1965–1971
Vincent McKelvey, 1971–1978
William Menard, 1978–1981
Dallas Peck, 1981–1993
Gordon Eaton, 1994–1997
Charles Groat, Nov. 1998–Sept. 2005
Mark Myers, Sept. 2006–Jan. 2009
Marcia McNutt, Oct. 2009–Feb. 2015
Suzette Kimball, Dec. 2015–Jan. 2017
James Reilly, May 2018–Jan. 2021
David Applegate, Aug. 2022–

Treasurer's Report

Treasurer's Report and Membership Statistics for 2022

This report summarizes the financial situation of the Geologic Division Retirees as of the end of 2022. The Treasurer's report for 2022 will not include any dues payments for 2022 as the Treasurer required sudden, nonelective open-heart surgery as the dues payment statements were being prepared. He is largely recovered and continues to improve daily. The 2023 dues notice will be included with the mailing of this newsletter and will have a line for 2022 dues.

Net Worth, January 1, 2021	**8,831.97**
2021-2022 Income	
Dues & Donations	2060.00
Total Income	2,060.00
2021-2022 Expenses	
Newsletters & Directory	5,362.87
Total Expenses	5,362.87
Total Assets, December 31, 2022	**5,629.10**

Note:

It is the custom of GDR to remove members from the membership list when they are over 3 years in arrears of their dues. Spouses of deceased members are removed from the membership list when they are over 2 years in arrears of their dues.

Membership Statistics:

At the end of 2022, we had 257 members. This is down 25 from the year before when we had 282 members. About 45 members are geologists emeritus.

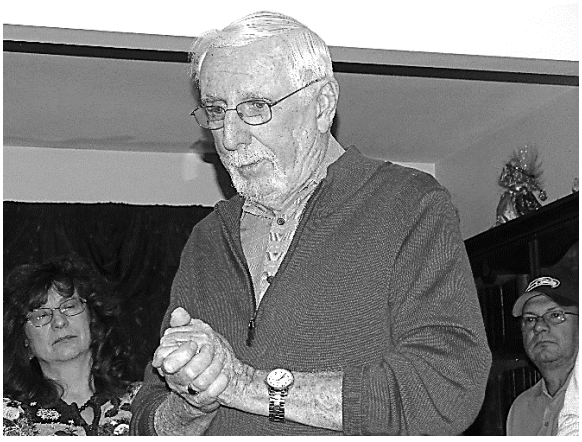
New Members

Allan Kolker
Dave Smith

Essays, Anecdotes, and History

"WHERE ARE THE OUTCROPS?!" and those who answered that question

Bill Cannon



I passed a good deal of the recent pandemic isolation doing a tedious job of digitally capturing data on the locations and lithology of previously mapped bedrock outcrops in the "Iron Country" of the Upper Peninsula of Michigan, a region of complex Precambrian geology but notorious for its sparse bedrock exposure. I have worked in this region for many periods throughout my career and continue as an emeritus, so know the situation well. I joined the USGS in September of 1967 and was assigned to the Marquette, Michigan, field office, where I was the third of three geologists permanently stationed there. Jack Gair was my supervisor and mentor and Willard Puffet filled out our team. We were joined by George Simmons from Denver and Lorin Clark from Menlo Park for summer field mapping and, together, were tasked with making detailed (1:24,000-scale) geologic maps of the Marquette Iron Range. Shortly after settling into my new surroundings, Jack took me to tour the quadrangle that was my first assignment (Greenwood quadrangle). Having just spent two summers mapping in my dissertation area in northern Ontario, where there was nearly 100% outcrop, I couldn't help but notice that, to first appearance, my new map area seemingly had no outcrops. With more than a bit of concern, I mentioned this to Jack who assured me that there were indeed some, but they had to be painstakingly sought out through the generally thick understory, alder swamps, nearly impenetrable regenerating clearcuts, and other impediments. In fact, part of our task was to find <u>all</u> of them and carefully record their locations and dimensions along with other standard geologic information, which was eventually reproduced on our final maps. This required covering the entire quadrangle with pace-and-compass traverses (long before modern navigation tools) spaced 300 feet apart; one hundred and fifty feet being the typical sight distance over which outcrops could be seen through the dense forest. A single 7.5-minute quadrangle required about 900 miles of traversing to fully cover by this protocol. In much of the area, traverses had to be done using sundial compasses because of very strong magnetic attraction of nearby rocks that rendered magnetic compasses useless. In the final analyses, it turned out that the Greenwood quadrangle actually has 1,660 individual outcrops by actual count, each of which was measured by pacing its extent and drawn onto field base maps for later compilation and publication.

My own contribution to the Iron Country mapping was only a small part of a 30-year-long effort by a large contingent of USGS geologists who mapped all the Michigan iron ranges and surroundings and located <u>all</u> the outcrops. The work began during WWII. The earliest indication of fieldwork that I have come across was in 1943 as a wartime critical minerals effort headed by Hal James. This detailed mapping effort continued, without interruption, for more than three decades and concluded when John Klasner and I completed the Three Lakes quadrangle at the western end of the Marquette Range in 1975. Much of this work was done in cooperation with the Michigan Geological Survey, who provided financial support over many years. All told, about 2,500 square miles were mapped, mostly at 1:24,000 scale, and mostly by this laborious method. The results were presented as an array of Professional Papers, Bulletins, I-maps, and GQ-maps, all of which provided locations and dimensions of every outcrop encountered overlain on the interpreted geology. More than once, I have been told by users of these maps that the outcrop locations are the most valuable of all the data presented. "Your interpretations are questionable, but knowing where to

go to find actual bedrock is an invaluable timesaver," to paraphrase. Let's remember that much of this work was done before plate tectonics was well accepted, especially for Precambrian rocks. Vertical tectonics still ruled the day.

Tedious as the digitizing was over many months, I was constantly reminded that it paled in comparison to the stunning amount of physical and intellectual effort that was expended by a long list of Survey geologists in accurately locating and recording each outcrop. Many of them were (are) colleagues and friends and I was constantly reminded of their dedication and field skills. When all digits were captured, there were approximately 50,000 individual outcrops in the Iron Country, each of which had been located, measured by pacing in most cases, and carefully recorded on field maps or air photos. As my digitizing work progressed, typically spending a minute or so digitizing each outcrop seemed rather trivial compared to the accumulated accomplishments of this group of Survey geologists, and I felt ever more strongly that they should be recognized individually for their lasting contributions, even if quite belatedly. Their products are still used widely today and, now in digital form, can be used in many modern GIS applications. Below is the list of those who contributed to the best of recollection. I'm sure there are names on this list that will be familiar to many of you, and I apologize if I have overlooked anyone. So, in alphabetical order, here is this distinguished group: Dick Bayley, Bill Cannon, Lorin Clark, Carl Dutton, Mike Foose, Jake Freedman, Jim Fritts, Jack Gair, Hal James, John Klasner, Gene Laberge, Carl Lamey, Francis Pettijohn, Bill Prinz, Willard Puffett, Bob Schmidt, Klaus Schulz, Paul Sims, John Slack, Bob Thaden, Virgil Trent, Jim Trow, and Ken Weir.

Kudos to this talented group and their lasting contributions.

Geology, Energy, and Mineral Resources of Ukraine

Paul Hearn

Historical Overview

Ukraine joined the Soviet Union in 1922, together with Russia, Belorussia, Azerbaijan, Armenia, and Georgia. For much of its history it has been a major source of wheat and other grains to Russia and surrounding countries. During Stalin's drive to collectivize agriculture in the early 1930s, Ukrainian farmers were forced to give up their farms and their supplies of grain were confiscated. The resulting Holodomor famine of 1932–33 killed an estimated 6–8 million people, 4–5 million of them in Ukraine.

After regaining its independence when the Soviet Union broke up in 1991, Ukraine declared itself a neutral state, forming a limited military partnership with Russia and other former Soviet countries while also establishing an agreement with NATO in 1994. In 2013, mass protests and demonstrations known as the Euromaidan erupted. These events resulted in a new government being formed, followed by Russia's annexation of the Crimea in 2014 and the subsequent

fighting against Russian-backed separatists in eastern Ukraine. Ultimately, this culminated in the Russian invasion of February 2022. Since then Ukraine has continued to seek closer economic, political, and military ties with the West (particularly NATO) amid the ongoing war with Russia.

Source: Grid Arendal. Topographic map of Ukraine. Authors Philippe Rekacewicz, Emmanuelle Bournay, UNEP/GRID-Arendal. https://www.grida.no/resources/5330.

U.S. Geological Survey Cooperation with Ukraine

Authorized by the Organic Act of 1879, the U.S. Geological Survey (USGS) has a long history of assisting other countries with assessing and responding to floods, earthquakes, landslides, volcanic eruptions, and water-supply and water-quality needs. In the late 1990s and early 2000s, the USGS was involved in several assistance programs in Ukraine, funded by the State Department's U.S. Agency for International Development (USAID).

From 1998 to 2002, USGS hydrologists, working closely with their Ukrainian counterparts, installed six satellite-linked stream gaging stations in the Tisa River Basin in western Ukraine. Preceded by discussions to explain how the gages would be linked by satellite to USGS servers, and to satisfy Ukrainian concerns, these telemetric gages were the first to be installed in the former Soviet Union.

In addition, USGS geologists conducted an assessment of landslide risk in the western Carpathian Mountains, where runoff from snowmelt often caused major ground failures and flooding. Support was also provided to other projects, such as the effort by the Environmental Research Institute of Michigan (ERIM), to install a satellite receiving station in Kyiv and establish the Ukrainian Land and Resource Management Center (ULRMC). The ULRMC's goals were to promote the use of remote sensing and GIS technologies to aid in environmental and natural resource management. The center was active until the early 2010s, and serves as a good model for future development.

The USGS team consisted of:

(1) Randall Updike, Chief Scientist, Geologic Hazards Team, Golden, CO;
(2) William Savage, Senior Landslide Engineer, Geologic Hazards Team, Golden, CO;
(3) Jonathan Godt, Research Geomorphologist and Geographic Information Systems (GIS) Specialist, Geologic Hazards Team, Golden, CO;
(4) Gregg Wiche, District Chief, WRD, Bismarck, ND;
(5) Paul Hearn, Office of International Geology, Reston, VA;
(6) Verne Schneider, WRD International Hydrology, Reston, VA; and
(7) Nick Van Driel, USGS EROS Data Center, Sioux Falls, SD.

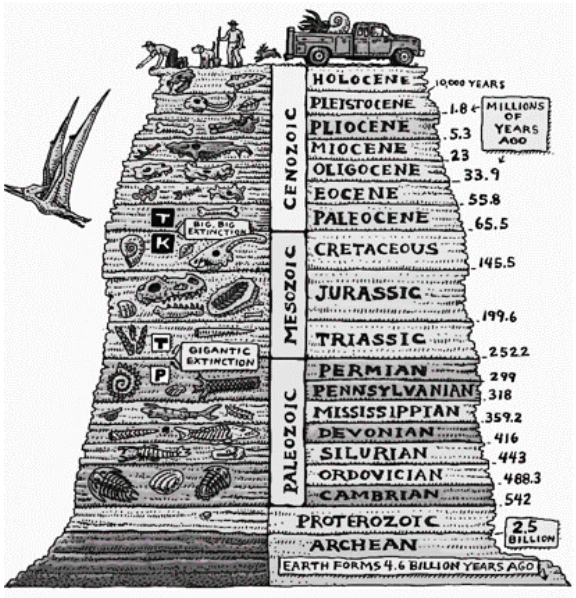
Ukrainian Geography

Ukraine is the second largest country in Europe after Russia, which borders it to the east and northeast. Ukraine also shares borders with Belarus to the north; Poland, Slovakia, and Hungary to the west; Romania and Moldova to the south; and has a coastline along the Sea of Azov and the Black Sea. It covers about 600,000 km^2 (230,000 mi^2), with a population of about 43 million. The nation's capital and largest city is Kyiv. While the official language is Ukrainian, most people are also fluent in Russian.

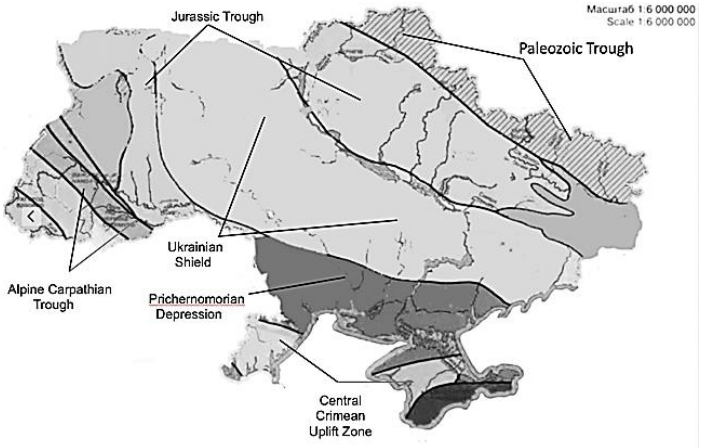
Located on the East European Plain, Ukraine is a relatively flat country, with maximum elevations of the Carpathian Mountains in the west reaching 6,762 feet (2,061 meters) and 5,069 feet (1,545 meters) and in the mountains of the southern part of the Crimean

Peninsula**.** Ukraine is most comparable in size to the State of Texas. To the south is the Black Sea, where the port city of Odesa is located. The Sea of Azov separates Crimea from Russia and eastern Ukraine. Separating the country roughly in half is the Dnieper River.

Geology



Cartoon showing geologic timescale.
Artwork © Ray Troll 2022.



Simplified geologic structures map of Ukraine. Source: Regional Information Center "Carpathians." http://carpaty.net/?p=22919&lang=en.

The oldest rocks in Ukraine are part of the Ukrainian Shield, forming more than 2.5 billion years ago in the Precambrian. Extensive tectonic evolution and several mountain building events during this time fractured the crust into numerous blocks, horsts, grabens, and depressions. Ukraine was intermittently flooded as the crust down-warped during much of the Paleozoic, Mesozoic, and early Cenozoic, before the formation of the Alps and Carpathians defined much of its current European topography. Lastly, Ukraine was impacted by Pleistocene glaciations within the last several hundred thousand years.

Energy, Mineral, and Agricultural Resources

Roughly 80 percent of Ukraine's oil, natural gas, and coal production is from the Dnieper-Donetsk region. Oil and gas deposits have been found in Neogene rocks of the Pre-Carpathian Foredeep, in Paleozoic rocks of the Dnieper-Donets Depression, and in Oligocene rocks of the Prichernomorian Depression. Large coal reserves are situated in the Dnieper Lignite Basin, Donets Basin, and Lvov-Volyn Depression. Additionally, Ukraine has combustible black shale and peat deposits.

Ukraine also has one of the largest supplies of recoverable rare-earth minerals in Europe. Rare-earth elements including cerium, yttrium, lanthanum, and neodymium are critical to the production of microchips, computer memory, and permanent magnets. Rare-earth elements are also used in smart phones, digital cameras, computer hard disks, fluorescent and light-emitting-diode (LED) lights, flat screen televisions, computer monitors, and electronic displays.

The Proterozoic Ukrainian Shield hosts iron ore deposits in the Krivorozhsky Basin, while iron ore is also found in the Neogene Prichernomorian Depression. Manganese ores are found in Oligocene rocks on the southern slope of the Ukrainian Shield, and titanium is found in magmatic and alluvial deposits. Tungsten, molybdenum, vanadium, nickel, cobalt, and chromium occur on the shield as well. Mercury deposits in the Donets Basin are hosted in Carboniferous sandstones as well as in the Transcarpathian Trough and Crimea, while copper is found in Permian rocks in the Donets Basin.

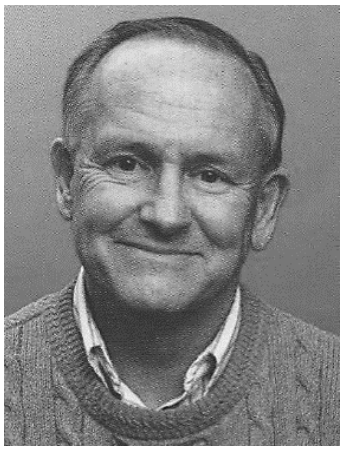
Also known as the breadbasket of Europe, crops make up about 73% of Ukraine's agricultural outputs. The primary crops grown are wheat, barley, soybeans,

sunflowers, and corn. Worldwide, Ukraine was the fourth largest exporter of corn and barley and the sixth largest exporter of wheat in 2021.

(Source: Canadian Broadcasting Corporation (CBC) https://www.cbc.ca/news/politics/natural-resources-ukraine-war-1.6467039)

Impact on the Earth System by Global Climate Warming—An Update

Richie Williams



In the summer of 2014 (GDR News, no. 69, p. 2–3), Warren B. Hamilton (1925–2018), a planetary-scale synthesizer, wrote an essay entitled, "Anthropogenic Global Warming." Warren addressed the global impact of the rapid increase in greenhouse gases (GHG), in particular CO_2 (carbon dioxide) and CH_4 (methane), and their impact on the Earth's oceans, lands, and atmosphere. After discussing a variety of topics, including the geologically important records preserved in glacier ice cores and in marine and terrestrial sedimentary deposits, and the range of past sea levels in the context of climate change, he concluded that "sustainable substitutes of sources of energy" must be developed, especially in the face of a strong, coordinated push back from the petroleum and coal industries.

John Keith asked me to update the 2014 Hamilton essay to reflect the current scientific perspective. Before beginning my essay, however, I want to comment that one of the greatest strengths of the USGS has been in its amazing group of farsighted scientists who, like Warren Hamilton, have always populated the scientific institution from its very beginning in March 1879 at least to the time its science-based divisions were eliminated by Director Marcia McNutt in 2010 and reorganized into seven amorphous, modular science-mission areas (USGS Circular 1383–B, 2013). Historically, the scientists, who had/have sterling national and international reputations in their respective geoscience disciplines and served, most importantly as "soothsayers" to upper-level management and as "mentors" to younger scientists. Here is an abbreviated list of many exceptional scientists whom I was fortunate to know personally during my career in the Survey: Eugene M. Shoemaker (1928–1997), astrogeologist; Arthur H. Lachenbruch (1925–2021), permafrost specialist; Mark F. Meier (1925–2012), glaciologist; Jim Moore, volcanologist, (1930–); Daniel R. Muhs (1950–), geomorphologist/long-term drought specialist; Robert I. Tilling (1935–), volcanologist; Vincent E. McKelvey (1916–1987), Director, and sea-floor minerals specialist; and I could continue!

I will begin with my update in discussing three aspects of the pressing need to achieve a better understanding of the challenges which lie ahead in our profession and the need for the new organizational tools to assist in their solutions. The first is a continuation of Hamilton's focus on greenhouse gases (GHG) and where we are 8 years later. The anthropogenic increase of CO_2 and CH_4 (and other GHG) in the Earth's atmosphere continues unabated, the result primarily of the production, transport, and burning of fossil fuels. CO_2 was 421 ppmv in the atmosphere in May 2022 at the NOAA observatory on Mauna Loa, Hawai´i. At the onset of the Industrial Revolution (ca. 1750), CO_2 was 280 ppmv in the atmosphere. Analyses of ice cores in Antarctica dating back through successive glaciations during the Quaternary indicates that the natural variability of CO_2 in the atmosphere ranges from 180 ppmv during a glacial interval to 280 ppmv during an interglacial interval, so the Earth's atmosphere has had a 50 percent increase in CO_2 since 1750. NOAA, in 2021, reported that CH_4 in the Earth's atmosphere was 1,896 ppmv, a 162 percent increase since 1750. The rapid warming of the land, oceans, and atmosphere is changing the entire Earth System.

The second update is that of the Earth System, in which Planet Earth can be holistically conceptualized as an interrelated, interconnected series of systems (or spheres), cycles, and processes, in which changes in any sphere, cycle, or process will cause changes in others. The Earth System concept emerged from the International Geosphere-Biosphere Programme (IGBP) which was manifested in the United States by the establishment of the 13-Federal agency U.S. Global Change Research Program (USGCRP) in 1989, including the U.S. Department of the Interior, in which the principal representative for DOI was a senior research scientist from the USGS. The Earth System includes the Geosphere, whose components are the Lithosphere, Hydrosphere, Atmosphere, and Cryosphere; the Biosphere, including all extant organisms in the five kingdoms on Earth divided into two divisions, Prokaryotae and Eukaryotae; the Sun (solar energy); two Cycles, Hydrologic Cycle and Biogeochemical Cycle, and one Process category, Climatic Processes . It was evident early on that the USGS, with its four science divisions, Geologic, Water Resources, Biological Resources, and National Mapping (including the ERTS Program developed within the EROS Program of the Director's Office), and staffed by top-flight scientific and engineers, could have played the dominant leadership role, especially if teamed up with NOAA, within the other Federal agencies in the USGCRP. This is because the organizational structure of the divisions of the USGS was ready-made for Earth System Science, especially GD for the Lithosphere, WRD for the Hydrosphere, including the all-important Hydrologic Cycle, and BRD for the Biosphere. Alas, the Director Dallas L. Peck (1929–2005) and the Chief Hydrologist Philip Cohen (1931–2022) were unenthusiastic and not supportive. In retrospect, the top science agency in Interior missed out on a "golden opportunity" to have a lead role in guiding the development of the most important national scientific program in more than a century and on a par with the Manhattan Project during World War II.

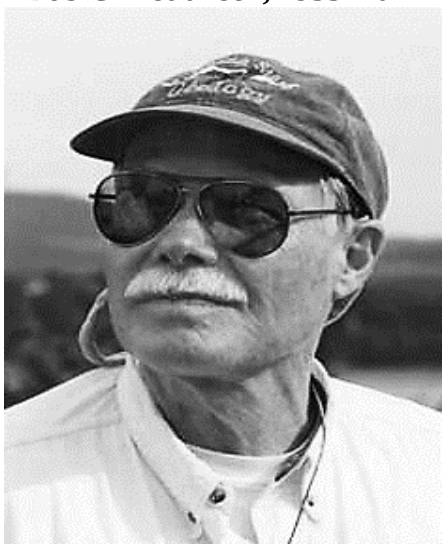
To take just one example, the current level of the ocean globally is, under the present continental configuration, the result of a variation in range of sea level during the Quaternary of 200 m, all dependent of the volume of glacier ice on land. During the last glacial maximum, sea level was about 125 m lower than today. The remaining volume of ice on land today in the two remaining ice sheets in Greenland and Antarctica, if completely melted, would raise sea level about 7 m and 68 m, respectively, for a total rise in eustatic sea level of 75 m, not counting the 0.5 m for all the estimated 200,000 mountain glaciers on the planet (ice caps, ice fields, valley glaciers, cirque glaciers); glaciers are an extremely sensitive indicator of regional changes in climate. The current rate of sea-level rise is about 4 mm per year and accelerating. The settlement of humans on deltas, and low-lying islands, such as barrier islands and atolls, and coastal regions for the past 3,000 years has assumed a constant sea level. The value of taxable land, houses, and other structures, and infrastructure (roads, airports, communication networks, etc.) will be lost (inundated) with the rise in sea level; the intrusion of ocean water into coastal aquifers will limit the use of groundwater by homeowners, agriculture, and industries; flood plains of coastal river systems will be inundated well inland. Relocation of people and infrastructure will be required to more reliable geological locations well above the projected rise in sea level.

The third is the concept of the maximum carrying capacity of Planet Earth with respect to the impact of just one species, *Homo sapiens*, on the total Earth System. At the start of the Industrial Revolution, the total population of humans on Earth was estimated to be about 800 million. When I was born in late 1938, there were about 2 billion humans on the planet. According to the United Nations Population Bureau, by mid-November 2022, the human population will exceed 8 billion, a four-fold increase in my lifetime; by the start of the 22nd century, the U.N. estimate is 10.4 billion humans! As the famous biologist, E.O. Wilson (1929–2021) said, if all the humans on Earth had the same standard of living as Americans do, we would have to have 2.5 Earths to support them. How many other animals and plants in Eukaryotae will still be alive after humans alter virtually all ecosystems in their insatiable demand for terrestrial and marine resources?

Other affiliation: Senior Associate Scientist,
Stefansson Arctic Institute, Akureyri, Iceland

Memorials

Bob Christiansen, 1935–2022



USGS geologist and the founding Scientist-in-Charge of the Yellowstone Volcano Observatory Robert (Bob) Christiansen passed away on September 15, 2022, in Palo Alto, California. Bob, or Chris, as his colleagues and friends often called him, leaves a legacy of scientific achievement, articulate writing, and a warm and humble personality that endeared him to all. He received his Ph.D. from Stanford University and then began working at the USGS in 1961. He initially worked for 10 years in the Denver, Colorado, office and then in the Menlo Park, California, office. He retired in 2003 but remained an active scientist emeritus until his death.

In the early 1960s, Bob worked with lifelong friend and colleague Peter Lipman on the distribution and character of volcanic deposits in southern Nevada. Together they interpreted and published on well-preserved examples of large, complicated ash-flow tuffs. Bob was part of a USGS group that was tasked in 1965 with creating a comprehensive geologic map of the young volcanic rocks in Yellowstone. Bob and his colleagues tried to understand when and how the volcano erupted, how much magma was vented, and where it went. From 1966 to 1971, Bob and USGS colleagues (mainly Dick Blank) spent the summer months in Yellowstone carrying out field work and mapping. In other times of the year, they analyzed aerial photographs, scrutinized the rocks they sampled, measured the chemical composition of the rocks, and determined their ages. The work lasted long beyond the initial field seasons as Bob and his collaborators worked to understand the complex geologic history of the region.

The results of these monumental efforts were published in a 2001 USGS Professional Paper that is a comprehensive description of the volcanic history of Yellowstone and a geologic map of the Yellowstone Plateau. Although very well known for his work in Yellowstone, Bob also contributed fundamental advances to our understanding of volcanoes throughout the United States. Between 1971 and 1973, Bob was stationed at the Hawaiian Volcano Observatory, where he investigated explosive eruptions at Kīlauea Volcano, including the tragic base surge in 1790 (which killed several hundred Hawaiians) with USGS colleague Don Swanson, and violent hydromagmatic eruptions that left extensive deposits in the volcano's summit region.

Bob was the Chief Scientist for monitoring and scientific analysis of the 1980 eruption at Mount St. Helens in Washington, where he detailed the chronology of eruptive activity. His work in the Cascades was not solely restricted to Mount St. Helens. With USGS colleague C. Dan Miller between 1973 and 1977, Bob mapped and studied the voluminous and long-lived Mount Shasta in Northern California. In the 1980s he returned to study its large sector collapse, which was only conclusively identified after the 1980 Mount St. Helens eruption left deposits that closely resembled those at Mount Shasta. In the 1990s and after retirement, he expanded his mapping east to connect with USGS colleague Julie Donnelly-Nolan's mapping at Medicine Lake Volcano. With USGS colleagues, in 2020 he published a detailed study of the remarkable Shastina eruptive phase of Mount Shasta.

Bob Christiansen will be remembered by his many colleagues and friends as insightful and meticulous in his many scientific investigations. In addition to his incredible scientific achievements, Bob served in several management positions at the USGS. He was the coordinator of the USGS Geothermal Research Program between 1976 and 1979, and he served as Chief of the USGS Branch of Igneous and Geothermal

Processes between 1987 and 1991.

Bob's comprehensive research at Yellowstone is the foundation for our current understanding of the volcanic, earthquake, and hydrothermal systems of Yellowstone. It is taught in every evening lesson by a ranger and written in every pamphlet and book on geology handed out in the park visitor centers. He will be sorely missed by everyone who knew him. We are better scientists and people and know far more about the volcanoes of the USA thanks to his wisdom, mentorship, and dedication.

Lawrence J. Drew, 1940–2022

Lawrence (Larry) Drew passed away on Thanksgiving morning in Fairfax, VA. Larry received his B.S. degree in geology from the University of New Hampshire where his advisor played a major role in steering him to graduate studies at Penn State where he studied under Professor John Cedric Griffiths. At their first meeting Larry told Dr. Griffiths that he wanted to do high temperature and pressure geology. Griffiths recommended statistics and mathematics courses instead, where he often found himself as the only geology major in class. Larry never did get to cook any rocks. He received his M.S. and Ph.D. in Mineralogy and Statistics, completing his graduate work in 1966. During his time at Penn State, he met an undergraduate named Sheila Collins from Philadelphia, PA. The two wed in the fall of 1966 and were married for 52 years until Sheila's passing in 2018.

After their wedding, Larry's career took them briefly out west to Denver, CO, then to the Geotech company in Alexandria, VA, where he analyzed oceanographic data. As Larry relates the story, he watched the company go through a series of staff reductions, which led him to conclude that government contracting was unlikely to lead to a stable research position. So, in August of 1969 he joined the research laboratory staff of Cities Service Oil Company in Tulsa, OK. At Cities Service, Larry learned the methods of operation of oil exploration and developed strategies for analyzing the outcomes of oil exploration plays. He also had a brief assignment analyzing the outcomes of mineral, particularly copper, exploration. These skills served as a basis for much of his later work at the USGS, where Larry began working in June of 1972.

Larry took great pride in his professional career at the USGS, and during his tenure there published over 100 scientific papers, authored and co-authored three books, and traveled the world attending conferences and collaborating with other scientists. Larry's early work on outcomes of exploration for porphyry copper deposits was a pioneering effort for mineral resource analysis. Larry served as the Chief of the Branch of Resources Analysis from 1983 to 1988. He received the Department of the Interior's Distinguished Service Award for his time as branch chief before transitioning back into high-level scientific research. After stepping down from the branch chief role, Larry spent more than a month in China with other USGS scientists studying the giant Bayan Obo rare-earths deposit and another month in Uzbekistan mapping the renowned Muruntau gold deposit.

In addition to his work on petroleum and minerals assessment, Larry published geologic maps of world class mineral deposits, studied sand and gravel deposits in New England, and analyzed groundwater resources in New Hampshire and Virginia. He showed that water resources followed the geological structure of the bedrock. Larry's years of research led him to a hard-won truth which he often repeated, "There's no such thing as automatic data processing."

He was honored several times throughout his career for exceptional contributions to the field. A raconteur, Larry's technical talks were frequently enlivened by amusing and insightful anecdotes that illustrated his points. In 2000, he received the John Cedric Griffiths Teaching Award, and in 2010 he received the William Christian Krumbein Medal from the International Association for Mathematical Geosciences. Larry is survived by his son Michael Drew, daughter-in-law Michelle Drew, and granddaughters Cassidy and Rebecca Drew.

Bob Earhart, 1928–2022

I met Bob Earhart on the first day of paleontology class at Ohio State University in the fall of 1953. The teacher reprimanded us for talking in class. This was the first, but not the last, time Bob got me into trouble. He proved to be troublesome for the next 69 years.

After graduation in 1955, Bob moved to Cedar City, Utah, to work for Columbia Iron; I followed that fall when I moved to Grand Junction to work for the USGS uranium program. We managed to meet occasionally during the next year; and in doing so we devised a plan for the 1956 Christmas season. We both had planned, independently, to spend it at home (Columbus). So we would just need one car, and we could trade off driving. Simple enough! But Bob suggested rather than just drive to Columbus, we should make it a ski trip. So we decided to go to Banff, Canada, for a few days skiing; then off to Columbus and after the New Year scoot back to western Colorado and eastern Utah. Then things got messy (they always seemed to if Bob was involved). For Bob to get back to work on Monday a.m., he needed to leave Columbus by Saturday morning. But I was to be part of a wedding party that Saturday night so I could not leave for Colorado until Sunday morning. (Bob worked for a company; he had to show up at 8 a.m. Monday; I worked for the USGS; who cares?) Clearly, we needed two cars. So we took two cars on a 2,500-miIe trip. That was Bob! No problem was too difficult!

By 1958, l found myself in graduate school in Boulder when I received a letter from Bob and George Simmons in Brazil. It contained a few grains of sand and an invitation to contribute to a gold mining operation in Minas Gerais. I sent them some Confederate script! For the next 20 or so years, I occasionally heard about Bob and his African river running but have no letters or other info. I'm sure you can get what you want (about him) from the foreign geology files in Washington. Twenty years later found him in Denver with the USGS, where he was assigned to the Wilderness Program in Montana. A few years later he was assigned to make a modern geologic map of Glacier National Park. By this time, I was working on trace element distributions in a copper-bearing shale in the area, and I joined Bob in much of his work in the mapping of the geology in Glacier Park. By 1991, I found myself mostly finished in Belt work and considering whether to find a new field problem or just retire, as I was then eligible.

One day I asked Bob if he wanted to go to lunch. He said "No," and then replied, "I want to go bike-camping on the Riviera in France." I decided to join him.

Thus began a 20-year-long series of bike-camping trips not only in this country but in much of the civilized world. Three times in France, once in the British Isles, including Ireland, New Zealand (more than once), even Australia. Most trips, of course, were in the Rocky Mountains (three times on "Ride-the-Rockies" —500 miles in a week, four 10,000-foot mountain passes, and lots of beer). Also included were many bicycle wine trips in Colorado and California. I personally biked over 20,000 miles in 20 years; and Bob did even more than that.

He died in Spring of 2022 shortly after suffering atrial fibrillation. I won't grieve. He was too full of life; too original. A really close friend, and I never really understood why.

—Jon Connor

Willie Lee, 1940–2022

The seismological community has lost one of its leaders and pioneers who led the creation of modern seismic networks while maintaining a sharp focus on the importance and value of the early instrumental and historical record. Willie was also a pioneer in such global seismology fields as seismic tomography. The Earth science literature abounds with hundreds of his

papers on diverse subjects under his frequently used moniker, WHK Lee.

Willie was born in wartime Guangxie, southern China in 1940, the sixth of seven children. His family fled to Macao in 1950 and then to Hong Kong in 1952. After secondary schooling in Hong Kong, he was accepted for study at the University of Alberta where he finished dual bachelor's degrees in Physics and Geology in 1962. He then sought graduate education in "someplace much warmer" and was accepted at Scripps Institution of Oceanography in San Diego and later UCLA, where he received a Ph.D. in Planetary and Space Physics for his work on the thermal history of Earth and planets in 1967. He was one of the earliest hired by the USGS in the fledgling National Earthquake Science Center (NCER) in Menlo Park.

At NCER, Willie was responsible for creating and managing the systems for efficient and timely analysis of the data from the nascent regional seismic network, the Calnet (now the Northern California Seismic Network). Willie oversaw all aspects of the network operations in Menlo Park, from selection of field sites to the detailed standards for processing and cataloging the data. He is well known for his rule of π, which states that "everything takes π longer than planned and costs π more than budgeted." From the first few stations in 1967, it grew to over 100 continuously telemetered and centrally recorded stations by 1970, complete with real-time processing, laying the framework for today's end-to-end monitoring of the San Andreas system and regional seismic networks across the U.S. and beyond. Willie pioneered the development of the coda magnitude scale and is famous for his hypocenter HYPO71 that is still in use today. He kept a sharp eye on the work of his skilled analysts, and with his red and blue tipped pencil personally reviewed the work before it entered the bulletin. With Sam Stewart, his wisdom was captured in their 1981 book *Principles and Applications of Microearthquake Networks*.

With the Calnet up and running, he turned his boundless energy to the study of seismicity across the globe, first focusing on compiling catalogs of China earthquakes from Chinese and other sources. Notably, the catalogs spanned millennia and documented the existence of sources in China that would not have been identified in catalogs spanning only a few centuries. These papers broadened the perspectives of many who were mapping seismic hazards in countries for which catalogs cover only a few centuries. He also co-organized the IASPEI/UNESCO program to inventory and microfilm seismograms from the pre-WWSSN (pre-early 1960s) era of seismology. The program inspired other preservation efforts focused on the seismograms of specific observatories. In all, over a half-million seismograms were microfilmed. He also co-organized and co-edited the *International Handbook of Earthquake and Engineering Seismology* [two printed volumes of 1945 pages]. Willie was also co-founder of the USGS Tsunami Source Working Group in 2011 that employs legacy historical seismograms and legacy marine seismic and bathymetric data to help give insights into why some subduction sectors produce great and giant interplate earthquakes and some do not.

In the early 1990s, with the digital revolution in seismology underway, Willie recognized the potential for advanced earthquake monitoring, including earthquake early warning. A force of nature, he worked tirelessly with his Taiwanese colleagues to realize this vision of the future, which paid enormous scientific and societal benefits in the 1999 Chi-Chi earthquake. Nothing was ever done on a small scale by Willie.

Willie officially retired from the USGS in 1995 but continued to lead the field in new directions for more than two decades. He was a driving force behind renewed interest in rotational seismology, the reassessment of tsunamigenic potential around the world and international efforts to preserve historical seismograms. Among his many honors, he was elected a Fellow of AGU (1992), received the USGS Dallas Peck Outstanding Scientist Emeritus Award (2006) and was awarded the Medal of the International Association of Seismology and Physics of the Earth's Interior (2015).

—Bill Ellsworth and Steve Kirby

Betty Miller, 1930–2021

Betty was born in Corunna, Michigan, and earned M.S. and Ph.D. degrees in geology from Michigan State University (MSU). She taught at MSU after

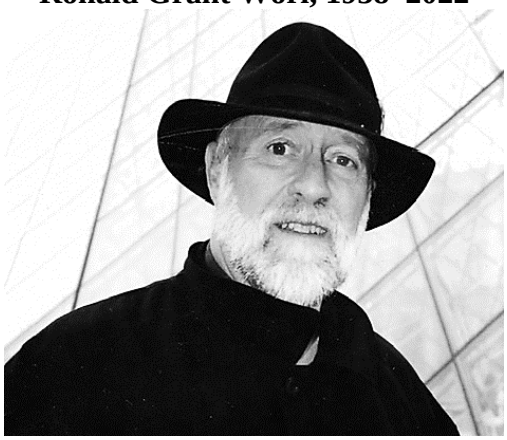
graduation in 1957, then was employed by the Pure Oil Company and the Sun Oil Company until she was recruited by the USGS in 1973 in Denver. Her specialty was the assessment of future U.S. petroleum resources. In 1981, she was appointed as an Assistant Director of the Survey in Reston by Bill Menard, the first woman to serve in that role. After retirement from the Survey, she taught at Central Michigan University for 2 years. She was a long-time member of the American Association of Petroleum Geologists and a Fellow of the Geological Society of America. She is survived by her husband Herbert Miller and many nieces and nephews.

Dick Ray, 1922–2022

This is to report the June 28, 2022, death of my father, Richard G. Ray, USGS Geologic Division employee from 1943–45 and 1946–60. He was 2 weeks shy of his 102nd birthday. Please see his obituary published in the *Washington Post.* In his earlier tenure at the Survey, Dick spent time surveying old copper and iron mines in the panhandle of Southeastern Alaska near Ketchikan. After an active-duty stint in the U.S. Navy toward the end of World War II, first in the Atlantic Theater and then in the Pacific, he was assigned to the Naval Office of Petroleum Reserves. In 1946 he returned to the Survey on Navy orders (in the Naval Reserve) as a party chief studying mineral deposits in the Maybe Creek area on Alaska's Arctic Coastal Plain. He also worked on oil exploration of Naval Petroleum Reserve No. 4 on Alaska's North Slope near Point Barrow. His studies for the Survey provided much of the data and stimulus for commercial research supporting construction of the Alaska Pipeline. As a field geologist at camps in Alaska in 1947, he worked on various mineral mapping projects. During 1948–50, he studied gold deposits in and around the Gold Cord Mine in the Willow Creek Mining District in southern Alaska, while finishing his Ph.D. at Johns Hopkins University. In the early 1950s his job moved him back to Washington, D.C., though he spent time in Alaska and in Colorado, where he studied uranium-bearing rocks in the Colorado Plateau. He wrote a Professional Paper on the up-and-coming use of aerial photogrammetry in geologic mapping in the late 1950s, which in 1960 led to a second career at the National Science Foundation, where he became Program Director for Geology. He always described his time at the Survey as the most exciting time in his life, and he wrote down many stories about his Alaskan adventures. Please feel free to contact me if you have any questions. I hope you can mention my dad's passing in the November Newsletter, although I'm not sure many of his old cronies who might remember him are still living!

—Dale Ray

Ronald Grant Worl, 1938–2022



Ron Worl, 84, passed away unexpectedly on October 17, 2022, at his home in Brunswick, Georgia. He was born January 16, 1938, in Dunlap, Iowa, to Carl and Ethelyne Worl. Ronnie led a varied and active childhood, enjoying building a tree house, racing his Soap Box Derby car, playing baseball, riding horses, helping at his father's service station, and feeding the pigs on the family farm. He earned money by delivering papers, growing watermelons, and detasseling corn.

In 1951, Ronnie's family moved to Pinedale, Wyoming. He soon became known to his new friends as Squirrel Worl, but to his family and others he was called Ronald and eventually just Ron. He participated in basketball, football, Future Farmers of America, and other school clubs. He embraced the outdoor life of Wyoming and enjoyed fishing, hunting, pack trips, boating, and exploring the mountain and desert areas near Pinedale. Ron helped at his family businesses: Worl's Ford Service and Camp Wilderness on Fremont

Lake. He also worked on several local ranches. For a number of summers, he fought forest fires and maintained trails for the U.S. Forest Service. These jobs taught him numerous skills and a strong work ethic that served him well throughout his life. After graduating from Pinedale High School in 1956, he attended Utah State University where he received a B.Sc. degree in geology in 1960. Ron's first job was as a geologist at the U.S. Steel iron mine north of Atlantic City, Wyoming, until the summer of 1961. At that point he enrolled at the University of Wyoming from 1961 to 1966 where he earned M.Sc. and Ph.D. degrees. The Buckhorn, The Cowboy, and Gene's bars in Laramie were major hangouts on weekends for Ron, Rich Ebens, and Fred Fisher. The annual Mountain Men celebration was a big part of Ron's Pinedale days.

Ron had three children from his first marriage to Patricia Lockyer: Christie, Scott, and Carl. His career as a geologist and family were intertwined and took them all over the world. Ron served two tours in Saudi Arabia with the Office of International Geology (OIG). Their children were with Pat and Ron during their first tour (1974–1979). The family learned to enjoy and appreciate the natural and cultural worlds of the Middle East, Africa, and Europe. Upon returning from overseas, Ron and family continued their adventures closer to home in Colorado and Wyoming. Ron enjoyed spending time hiking, camping, fishing, exploring, and sailing with his children and grandchildren. Teaching them the skills he had learned as a young man was important to him.

He taught geology courses at Colorado State University from 1966 to 1968 before beginning a 33-year career with the U.S. Geological Survey (USGS). In April 1966, Ron signed on with the USGS and worked part time as a WAE. During his career with the USGS, Ron was involved with numerous projects. Two of these were tours of duty in Saudi Arabia, first from April 1974 to June 1979 as Technical Advisor in Geology then later from November 1996 to January 2003 as Chief for the USGS Mission. During his first tour he led a project to map and explore an area of gold mineralization called Madh adh Dhahab (Cradle of Gold) that had been mined for gold and other metals at least three times before, starting about 3,000 years ago, possibly during the reign of King Solomon of Israel. Under Ron's direction new ore bodies were discovered and a new mine was opened by the Saudi Arabian government during the 1990s. Ron also conducted reconnaissance of ancient mines in the southern part of the Arabian Shield and identified several areas that were recommended for additional exploration. Upon returning from Saudi, Ron rejoined the Branch of Central Mineral Resources in Denver as a chief for a wilderness project in Wyoming. In the early 1990s, he moved to Spokane, heading up that office, and then served as Chief of Western Mineral Resources Branch. In his second Saudi tour, Ron served as the USGS Mission Chief of the partnership program for the development and implementation of the Saudi Geological Survey. In 2003, Ron turned off the lights and officially closed the Saudi project.

Dearest to his heart was the geology of the Wind River Mountains. These mountains were the subject of his Ph.D. dissertation and USGS studies, of which he was the project geologist. After retiring from the USGS in 2003, Ron spent 11 years doing private consulting that took him to Africa, Australia, and the Middle East. His career provided an outlet for his love of travel, exploration, and learning. Ron is credited with more than 100 professional publications.

The culmination of one of Ron's last forays in the Wind Rivers is a true picture of his humor. Bob Smith, Jerry VanVoorhis, Fred Fisher, and Ron did a week-long backpack trip in the Wind Rivers and were down to eating fish and oatmeal at the end. After a long muddy hike out, they got picked up and taken back to Pinedale, where they cleaned up. Off to the Patio Grill for big steaks and a hearty meal. All the guys got their steaks, but Bob was served oatmeal—another of Ron's pranks.

Ron enjoyed travelling with his second wife Alison, whom he met during his second tour in Saudi Arabia. They took adventurous trips throughout Saudi Arabia, Africa, and Asia. Highlights included having an island in the Red Sea named after Ron, exploring along the "Incense Route" (the world's oldest trade route), and visiting the ancient city of Angkor Wat. Fremont Lake was home for Ron's last summer where he and Alison volunteered as campground hosts. He thoroughly enjoyed sharing his knowledge of the Wind River Range with campers and telling them his favorite

hiking trails and fishing spots. It always thrilled him to run into old friends from Pinedale whom he hadn't seen since childhood. He was truly a force of nature with his capable ways and brilliant mind.

Ron was preceded in death by his parents, son Ronald Scott Worl, and former wife Pat Worl. Ron is survived by his wife Alison of Brunswick, GA; children: Christie Lambert (Jens) of Huntsville, AL, and Carl Worl (Alex) of Westminster, CO; grandchildren: Chelsea and Justin Perez, Michael, Andrew and Tori Worl; great grandson Rip Worl, and stepsons Rob and Michael Huff. He is also survived by his sister Mary Lynn Worl of Pinedale.

—Mary Lynn Worl, Chuck Thorman, Jim Elliott, Dave Lindsey, Greg Fernette, and Bob Smith

A memorial service is planned for the summer of 2023 in Pinedale. Because Ron was so at home in his natural surroundings the family asks that memorial donations be made to Friends of Bridger-Teton at https://www.btfriends.org/ron-worl or sent to P.O. Box 188, Jackson, WY 83001.

(In addition to this memorial, Pat Leahy sent the following remembrance of Ron. Pat was Chief Geologist during Ron's time in the USGS Saudi Mission.—Editor)

John, I am sorry to hear the sad news about Ron. I didn't recognize the other names in the Denver group you mentioned except for Jim Elliott. I believe he was with Ron in Saudi, and I met him there.

Ron did a great job in Saudi. Leading that office had numerous challenges that no other leaders in USGS faced. I remember with great fondness several visits over there, and Ron always made sure that there was a good field trip. There was a lot of geology to see, but he always put some time aside for fun—staff reception at the pool, visiting souks especially gold and rugs. I have a few trinkets from those excursions. I should also mention the field camp down by Mecca. Snorkeling in the Red Sea was a once in a lifetime experience for a geologist.

On the humorous side, during one of Ron's visits from Saudi to Reston, I received a call that the Deputy Secretary, Steve Griles, would like for Ron and me to visit with him to discuss the Saudi project. Ron and I dutifully showed up for the meeting at DOI, and after about 5 minutes the real reason for the meeting was clearly not the mission. Ron was quite an expert on Oriental rugs. Steve was quite proud of the gigantic Oriental rug that was in his office. On loan from the Smithsonian, I suspect. Steve wanted to get Ron's opinion on the quality and provenance of the rug. Quickly, Ron was on his hands and knees going tooth and nail over both sides of the rug. Steve was looking on with great excitement, and then Ron told him it was a fake—but a very high-quality one. Steve clearly was quite disappointed, and I could see the future USGS budget requests tumbling. We quickly were shown to the door. I remember asking Ron why he didn't just tell him it was great, and he said, "well, he asked!" On a more serious side, Ron was in charge of the office before, during, and after 9/11. Ron showed great leadership during these times. He kept me well informed about safety, etc. One day he called and said that the attitudes of the younger Saudi staff were definitely becoming anti-American and that it was time to evacuate U.S. staff. Most dependents had already left. I spoke to Chip Groat, and we agreed to close the mission, which was winding down anyway. However, after decades in Jeddah, leaving required time to close out the mission, Ron stayed on alone another several months to complete the exit without any problems. Ron was a truly dedicated USGSer. He thought of the organization first, embraced its mission fully, and did his best to see it successful.

Other Deaths

Mel Beeson, 1937–2021

Nancy Dutro, 1927–2022

Dick McCammon, 1932–2022

Paul Orkild, 1928–2022

RETIREE PUBLICATIONS
2019 – 2022

Note: The references below are compiled from information available as of 30 November 2022. These references are "new" since the Spring 2022 Newsletter (Number 82). An effort is made to compile **ALL** known publications (whatever year) by Geologic Division Retirees (GDR) for inclusion in the Master List of GDR Publications (now being maintained and updated by Bob Tilling). Please send complete references for any new publications (**but not those still "in press"**) to Bob (e-mail: volkno.rit@gmail.com or rtilling@usgs.gov), with cc to Jim McNeal (e-mail: jmcneal@usgs.gov) as back-up, for listing in the next Newsletter and for updating the Master List.

JOHN F. SLACK publications:

Slack, J.F., 2022, ***Perspectives on premetamorphic stratabound tourmalinites***: Journal of Geosciences, v. 67, p. 73–102.

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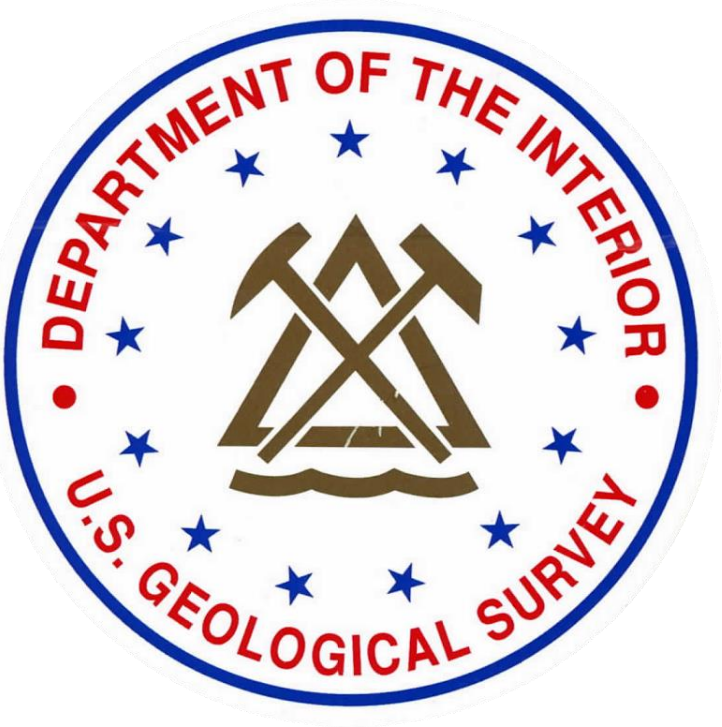
This magazine is produced by the Geologic Division Retirees Association. Government funds are not used in its production.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