Draft Minutes for the 1591st meeting of the Geological Society of Washington
September 13th, 2023
American Geophysical Union

President Kori Newman called the meeting to order at 20:08 EDT.

Attendance
There were 33 attendees in person and 29 attendees online via Zoom.

Minutes
The meeting began with the approval of the minutes from the previous meeting (1590th). The minutes of the 1590th meeting had been posted online and a Minute's Minute was read aloud at the 1590th meeting. No corrections were noted, and the minutes were accepted as read.

Guests and New Members
Two new members were announced: Kuan-Yu Lin, University of Delaware; and Nitin Kadam, Smithsonian Institution.

Nine guests were introduced: Nick Kellermann, STR; Lisa Ritter, STR, Noah Fleischer, ECS; Sarah Hall, AAAS; Richard Lewis, DTRA; Chuck Estabrook, NOAA; Hunter Gabbard, DARPA; Anne Van Horne, University of Wyoming; Bob Kieckhefer, Thailand.

Announcements
One announcement was made. Secretary Lederer announced a vacancy for Meeting Secretary – interested individuals may contact him directly.

Obituaries
No obituaries were read.

Informal Communication
No informal communications were read.

Formal Program

The formal program commenced at 20:20 EDT and with the Bradley lecture entitled "Precision Seismology, with Applications to Signals Old and New" delivered by Paul G. Richards of Lamont-Doherty Earth Observatory, Columbia University.

Seismology is an observational science. When earthquakes occur, many types of seismic waves (P-waves, S-waves, etc.) are produced and travel through the earth. Detectors on the Earth's surface, called seismometers, record the waves as they pass by, producing a record called a seismogram. Traditional methods measure the difference in time between the first arrival of the P-wave and the first arrival of the S-wave; because the waves travel through the Earth at different velocities, the time difference in the arrivals can be used to calculate the distance from the origin point of the earthquake. Using at least three seismometers, these distances can be triangulated to determine the location of an earthquake to within about 10 to 20 km. The traditional methods, however, are limited by three fundamental flaws: 1) only a small fraction of the information in a seismogram is used, 2) the first-arrival signals are small, and 3) converting time to distance requires knowledge of the Earth's interior. More precise seismological observations can be made by using the entire waveform contained in a seismogram. By studying earthquake doublets, which are seismic events that produce nearly identical seismograms, more

information about the interior of the earth and more precise locations and timing of seismic events can be obtained.

Three applications of precision seismology were presented: 1) measuring the seismic anisotropy of the Earth's solid inner core; 2) delineating faults in China; and 3) quantifying the timing of nuclear tests from historical seismic records. The existence of the Earth's solid inner core was proposed by Danish seismologist Inge Lehmann in 1936. A theoretical consequence of the inner core consisting of a solid crystal of iron is that seismic waves would propagate faster in one direction than another, a phenomenon known as anisotropy. By measuring earthquakes originating in the South Sandwich Islands recorded on seismic stations in Alaska, and overlaying seismograms measured 15 years apart, Xiaodong Song observed that waves passing through the inner core arrived at different times, leading him to conclude not only is the inner core anisotropic, it rotates on timescales observable by humans. China experiences many earthquakes, which are clustered along major faults. By using earthquake doublets and full waveforms recorded over 20 years, individual fault surfaces were delineated to within 2 km. Similarly, using 5 years of data in Mongolia and "template" examples of large earthquakes allowed for the recognition of 33x more events, or microseisms, that are not easily discernable by the human eye. Some of these events are anthropogenic, such as those induced by chemical explosions from coal mining in Russia, and can be recognized by the time of day and day of week they occur. Lastly, many nuclear tests were conducted in the 1950s through 1970s prior to the test ban treaty and recorded by analog methods. By digitizing paper seismograms and using records from of the Trinity program in New Mexico, the precise origin time of the nuclear test was determined. The event has historical significance as the first test of the implosion principle of a plutonium core in 1945 and was previously recorded incorrectly by ~1 hour owing to a misinterpretation of Mountain War Time.

Talk length: 50 minutes.
Questions were asked by: Liz Cottrell, Smithsonian; Larry Meinert, GSW past-president; Mong-Han Huang, UMD; Michael Purucker, NASA Goddard; Chuck Estabrook, NOAA; Ved Lekic, UMD; and George Helz, UMD.

President Newman adjourned the meeting at 21:47 EDT.

Respectfully submitted,

Graham Lederer