ONE HUNDRED YEARS OF GEOLOGY AND HYDROLOGY PAPERS PUBLISHED IN THE *PROCEEDINGS OF THE SOUTH DAKOTA ACADEMY OF SCIENCE*

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ABSTRACT

In 2015 The South Dakota Academy of Science celebrated one hundred years of publication of the Proceedings. This paper is written as part of the historic contributions to the Academy, focusing on the nearly two hundred papers dealing with geology and hydrology that have been published in the Proceedings. Emphasis in this paper is given to papers that are concerned with the Missouri River and the Homestake gold mine.

Keywords

Geology, hydrology, Missouri River, Homestake mine

INTRODUCTION

During the past 100 years there have been 180 full papers published in the Proceedings of the South Dakota Academy of Science that are primarily concerned with geology, paleontology, or hydrology. In addition, there are numerous abstracts published in the Proceedings that touch on these subjects.

The purpose of this paper is to briefly review several of these papers and show how they have contributed to their respective disciplines. Since there have been so many papers published in the Proceedings that have been written about diverse subjects within the general areas of geology and hydrology, it is not feasible to discuss all these references. Therefore, only a few citations are given in this paper, and two general themes are chosen that represent important works from both "East River" and "West River" within the State of South Dakota. In this endeavor, the two chosen themes are: the Missouri River and the Homestake Mine.

Missouri river—The Missouri River (Figure 1) is the most important hydrologic feature in South Dakota. It separates the glaciated East River, with its rich farmland, from the unglaciated ranch lands of West River.

Historically, the U.S. government acquired the Missouri River basin as part of the Louisiana Purchase, and in 1804 the Lewis and Clark expedition traveled

Figure 1. Drainage basin of the Missouri River (From Rahn, 2004).

up the Missouri River, encountering numerous Indian tribes as the expedition explored for a water passage to the Pacific Ocean (DeVoto 1953; Ambrose 1996). Meriwether Lewis and William Clark described the geography of the Missouri River and the flora and fauna as they explored for the Northwest Passage. Later in the 19th Century, the Missouri River served as the main route of transportation throughout the region, and South Dakota towns such as Yankton, Vermillion, Springfield and Pierre served as ports for steamboats.

The Proceedings of the South Dakota Academy of Science contain a number articles that deal with the Missouri River. An early paper by Kirby and Abbott (1930) deals with the 1881 Missouri River flood in the Vermillion area. Figure 2 shows maps with the location of the river prior to 1881, and the new channel after the 1881 flood (as it appeared in 1930). The paper by Kirby and Abbott illustrates that rivers can dramatically change position by sudden flood events. These dramatic shifts supplement the gradual changes in river position by continual meander migration from erosion on the outside of a meander ("undercut bank") and deposition on the inside of a meander ("slip-off slope"). Dramatic shifts profoundly impact citizens of a river port town because they suddenly find they are no longer near the river.

Examples of fluvial processes are illustrated by other papers in the Proceedings. For example, Rahn (1976, 2004) described changes in the Missouri River erosional and depositional pattern following dam construction upstream of Yankton. It was found that erosion no longer proceeded only on the outside of a meander, but proceeded along both sides of the river. Changes brought about by

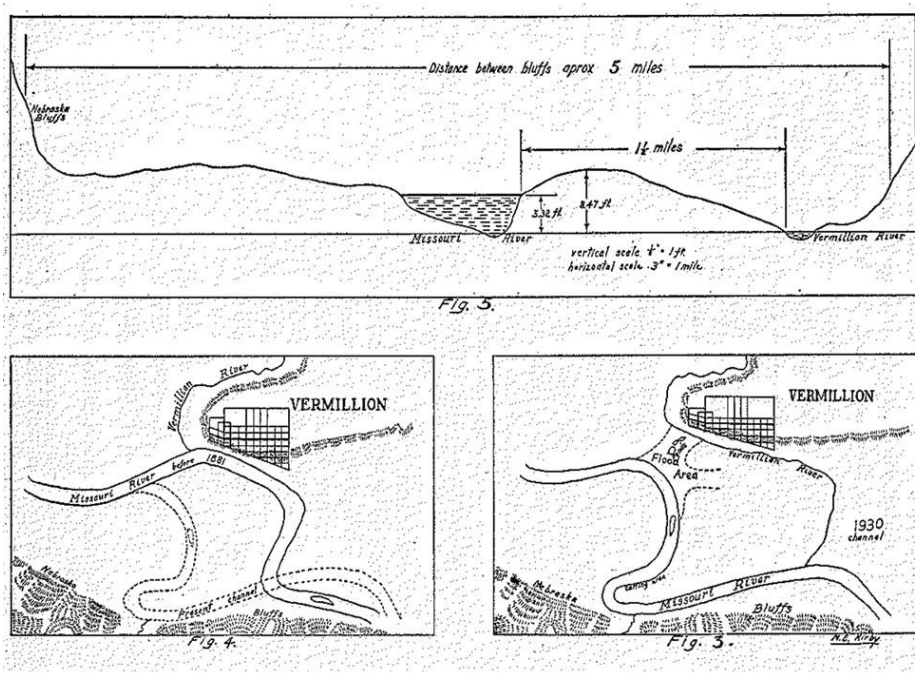

Figure 2. Map of Vermillion area showing the position of the Missouri River before and after the 1881 flood (From Kirby and Abbott 1930).

channelization of the Missouri River between Yankton and Saint Louis includes dikes and revetments in an attempt to keep the channel in the same place, and deep enough for barge transport.

Homestake Mine—There are numerous articles published in the Proceedings that deal with geology and hydrology in the Black Hills and adjacent areas, such as the Badlands. One important subject is the Homestake Mine in Lead. This mine has supplied 40 million troy ounces of gold since it began operation in 1878 until it closed in 2001 (Mitchell 2009). [Interestingly, using the density of gold, this weight is equivalent to a volume of a cube 13 ft (4 m) on a side.] Thus, the Homestake Mine has been an important domestic source of gold, and was an impetus for the establishment of the South Dakota School of Mines.

The Homestake Mine is the second deepest mine in the world, extending to a depth of 8,150 ft (2,308 m) below the land surface. The mine contains over 300 miles (480 km) of drifts, shafts, and underground workings. Figure 3 is a cross section of the Homestake Mine. The mine was abandoned in 2001, and in 2003 the pumps were shut off, allowing groundwater to flood the workings, reaching 20 ft (6 m) above the 4,550 ft (1,387 m) level (Mitchell 2009). Rahn and Roggenthen (2002) published a paper in the Proceedings that showed a model that predicted the rate of rise of water. In 2008, pumps were activated, and the mine dewatered to 4,850 ft (1478 m) level, ensuring that this level could be used for a neutrino laboratory. Stetler et al. (2010) published a paper in the

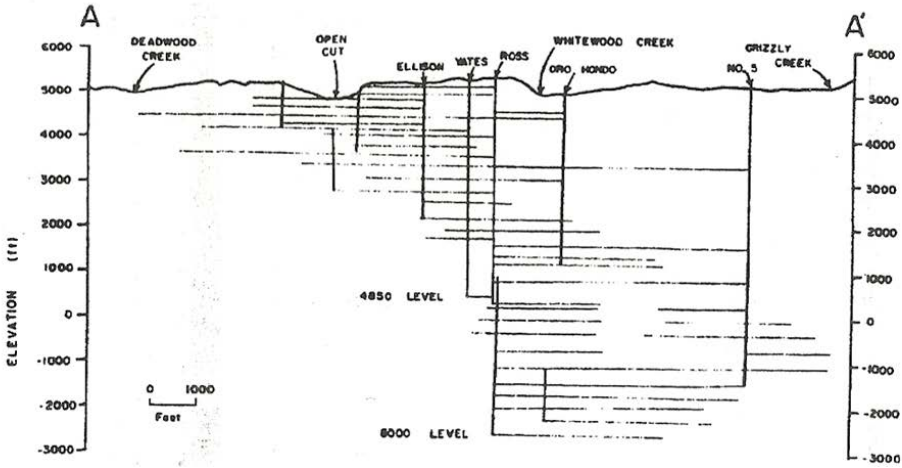

Figure 3. Cross section of Homestake Mine showing the Ross and Yates shafts as well as numerous drifts (From Rahn and Roggenthen 2002).

Proceedings that shows the water level and instrumentation used to study the groundwater level (Figure 4). Hydrologic data collected at this unique location has contributed to the understanding of hydrogeology of metamorphic rocks at great depths.

Rothrock (1941) published a paper in the Proceedings that describes the general Precambrian geology of South Dakota. In the Black Hills the Precambrian rocks are largely metamorphic rocks such as schist and quartzite. Hart et al. (2014) described the geology at the Homestake Mine; Figure 5 shows Precambrian schist and metagabbro intruded by Tertiary rhyolite. The disposition and density of various rocks types surrounding the Davis Campus Laboratory for the Sanford Underground Research Facility (SURF) is important for physics research because at the 4850 level shielding from cosmic rays is critical in order to detect neutrinos.

SUMMARY

Geology and hydrology articles published in the Proceedings of the South Dakota of Science have contributed to our scientific knowledge in these areas. In this paper examples of research are given for papers concerned with the Missouri River and the Homestake Mine. A complete discussion of all the geology and hydrology articles published in the Proceeding in the last 100 years is beyond the scope of this paper. Nevertheless acknowledgment is due to the many authors of all the published papers.

From a personal perspective, the author found that, in addition to the published works, a highlight of his association with the South Dakota Academy of Science has been the personal contacts and comradery that is present at the annual meetings of the Academy.

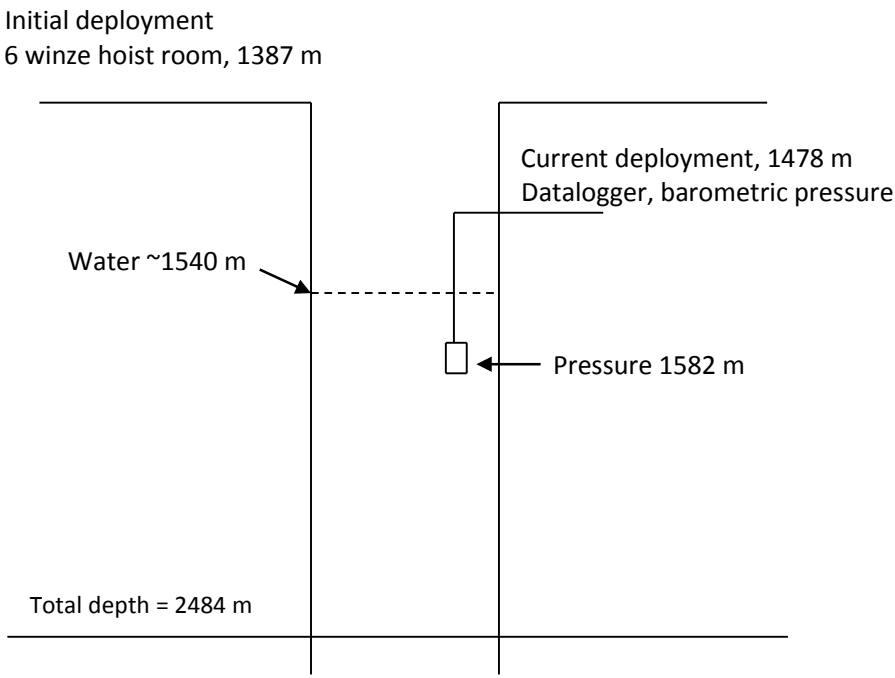

Figure 4. 2008 water level in the No. 6 winze and instrumentation in the Homestake Mine (From Stetler et al. 2010). The elevations shown are the distance (meters) below the land surface.

Figure 5. Three-dimensional geologic model of the Homestake Mine (From Hart et al. 2014).

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