

The Preglacial Missouri-Yellowstone and Interglacial Spiritwood Buried Valleys in the Brandon Area, Southwestern Manitoba

David Toop

Buried valley aquifers in Alberta and Saskatchewan constitute an important groundwater resource in these provinces. The aquifers were deposited by Tertiary aged river systems in broad valleys. Modern drainages in these provinces often follow similar courses to Tertiary drainages.

Multiple glacial advances and retreats during the Quaternary Period have altered the landscape, leaving modern drainage dramatically altered from preglacial times. Buried valley aquifers in Manitoba can originate from the Tertiary deposits of preglacial river systems or from Quaternary deposits of interglacial drainages. Both Quaternary interglacial and Tertiary preglacial buried valleys are represented in the region south of Brandon.

As the Laurentide Ice Sheet pushed through southern Manitoba into Montana and North Dakota it blocked the courses of east and north-east flowing rivers. Water ponded against the ice front and created a series of glacial lakes. Flow was eventually diverted around the ice to the southeast into the Mississippi drainage system. Sudden releases of water from the glacial lakes, incised U-shaped trenches deep into glacial drift or bedrock in a matter of days or weeks. The streams and rivers that reoccupied these trenches between glacial advances, deposited a variety of sediments, including some coarser aquifer material, before the valleys were buried by the next glacial advance. These could take the form of sluggish under-fit streams, major trunk rivers from the west, glacial meltwater streams, or a combination of these depending on reach. Consequently the distribution, morphology and aquifer properties of sediments within these valleys are more complex and variable, and generally less reliable than those found in better-known preglacial buried valleys.

The interglacial Spiritwood buried valley aquifer is the largest and most significant buried valley aquifer of its type, extending from South Dakota, through North Dakota into Manitoba. The Spiritwood lacks surface expression. It is mapped as a named aquifer only in North Dakota, where it can be 5 to 10 km wide and 45 to 90 m deep and locally may yield in excess of 30 L/min. The Spiritwood takes the form of a braided river complex within a U-shaped valley having one or more interweaving valley segments. The buried valley extends into Manitoba east of Turtle Mountain, continuing north to Brandon, although the aquifer qualities of infilling materials deteriorate to the north.

The modern day Yellowstone River is part of the Mississippi River system. It originates in Yellowstone National Park, Montana and flows northeast into North Dakota where it joins the Missouri River. The Missouri's present course in Montana between the Cypress Hills and North Dakota border approximates the southernmost extent of glacial ice. Prior to glaciation the Yellowstone and Missouri Rivers flowed north into Saskatchewan where they merged. The Estevan buried valley aquifer represents the former channels of the Missouri and Yellowstone rivers and is an important aquifer in Saskatchewan.

The preglacial Yellowstone-Missouri buried valley aquifer can be traced in Manitoba in the region south of Brandon, where it forms an important water supply for the Town of Souris. The buried valley lacks surface expression, is up to 40 m deep and is about 900 metres wide. The aquifer is likely discontinuous as a consequence of erosion.

“Souris sand and gravel” is a term used in Manitoba to describe both Tertiary gravels originating from the Rocky Mountains, found in preglacial buried valleys, and reworked Tertiary gravels mixed with glacially sourced gravels in interglacial buried valleys. Souris Gravels in southwestern Manitoba have a distinctive mineralogy consisting of quartzite, chert, petrified wood, agate, jasper and volcanics, often mixed with glacially derived carbonate, silicified shale and granite clasts. Terrace gravels near the town of Souris have long been an attraction for collectors seeking semi-precious gemstones and locally unique rock types.

The Yellowstone River is the only documented source of alluvial gravels containing agates and volcanics. Agate is found in the gravels of the modern Yellowstone River from the mountains near Yellowstone National Park down the length of the river almost to the North Dakota border. The agates disappear from the river where it diverts away from its preglacial course to its modern more southern drainage.

Souris gravels are found in the region south of Brandon in the Missouri-Yellowstone buried valley extending from the Town of Souris, east 35 km to the Souris gorge. At the Souris gorge, the Missouri-Yellowstone buried valley is eroded away by the deeper Spiritwood valley. A train of reworked Souris Gravels mixed with angular glacial gravels extends south along the Spiritwood buried valley. Between glaciations, the Yellowstone River probably entered the Spiritwood valley at this point and flowed south, accounting for a disparity in aquifer deposits in the Spiritwood valley. Good aquifer materials are found south of this point, whereas aquifer potential to the north is poor.