Appendix 6

The Cypress Hills Gravel

The Cypress Hills are a broad, eastward-extending anticline ¹ that has been planed on generally horizontal sedimentary rocks. In a few locations, the Cypress Hills planation surface bevels dipping sedimentary rocks. ² Steep slopes separate the plateau from the plains to the north. To the south a "pediment-like" planation surface slopes gently away from the plateau^{3,4,5} to the level of the plains. The plains are also a generally flat planation surface (the Flaxville planation surface) with occasional beveling of the sedimentary rocks.⁶ Pediments are one of the geomorphological subjects of volume III.

Predominantly Quartzite Gravel from the Rocky Mountains

The gravel or conglomerate capping the Cypress Hills is weakly stratified, poorly sorted, imbricated, and clast supported.^{7,8,9,10} The western and central Cypress Hills have a few fine-grained interbeds. Gravel in the western area lies on the Ravenscrag Formation (locally it lies on the Frenchman Formation) which consists mostly of soft silt and clay with minor cross-bedded sandstone.^{1,11} Lozenge-shaped sandstone rocks from these formations are sometimes found within the Cypress Hills Formation.¹ The Cypress Hills gravel rests on a slightly uneven planation surface with a relief of less than 50 feet (15 m).¹⁰ In the eastern Cypress Hills, the coarse gravel is estimated up to 245 feet (75 m)

¹ Furnival, G.M., 1950. Cypress Lake map-area, Saskatchewan. *Geological Survey of Canada Memoir 242*, Canada Department of Mines and Technical Surveys, Ottawa, Canada.

² Williams, M.Y. and W.S. Dyer, 1930. Geology of southern Alberta and southwestern Saskatchewan. *Geological Survey of Canada Memoir 163*, Canada Department of Mines, Ottawa, Canada, p. 69.

³ Jungerius, P.D., 1967. The influence of Pleistocene climatic changes on the development of the polygenetic pediments in the Cypress Hills area, Alberta. *Geographical Bulletin* 9:218–231.

⁴ Vreeken, W.J. and J.A. Westgate, 1992. Miocene tephra beds in the Cypress Hills of Saskatchewan, Canada. *Canadian Journal of Earth Sciences* 29:48–51.

⁵ Barendregt, R.W., W.J. Vreeken, E. Irving and J. Baker. 1997. Stratigraphy and paleomagnetism of the late Miocene Davis Creek silt, east block of the Cypress Hills, Saskatchewan. *Canadian Journal of Earth Sciences* 34:1,325–1,332.

⁶ Crickmay, C.H., 1932. The significance of the physiography of the Cypress Hills. *The Canadian Field-Naturalist* 46:185–186.

⁷ Russell, L.S., 1953. Tertiary stratigraphy of southwestern Saskatchewan. In, Parker, J.M. (editor), *Billings Geological Society Guidebook, Fourth Annual Field Conference*, Billings Geological Society, Billings, MT, pp. 106–113.

⁸ Russell, L.S., 1965. Macropalaeontology of the surface formations, Cypress Hills area, Alberta and Saskatchewan, *Alberta Society of Petroleum Geologists 15th Annual Field Conference Guidebook*, part I, pp. 131–136.

⁹ Westgate, J.A. 1968. Surficial geology of the Foremost—Cypress Hills area, Alberta. *Research Council of Alberta Bulletin 22*, Edmonton, Alberta.

¹⁰ Leckie, D.A. and R.J. Cheel. 1989. The Cypress Hills Formation (upper Eocene to Miocene): a semi-arid braidplain deposit resulting from intrusive uplift. *Canadian Journal of Earth Sciences* 26:1,918–1,931.

¹¹ Russell, L.S., 1948. The geology of the southern part of the Cypress Hills, southwestern Saskatchewan. *Saskatchewan Department of Mineral Resources Report Number 8*, Saskatoon, Saskatchewan.

thick,¹² although some investigators estimate a maximum thickness of 490 feet (150 m).¹³ This area contains many more sand interbeds (Figure A6.1) with local deposits of unstratified, mixed sediments interpreted by some as debris flow deposits.^{10,14} The presence of many more fine-grained interbeds may explain the disparity in the reported thickness of the eastern Cypress Hills Formation. Many mammal fossils are found within the sandy interbeds of the Cypress Hills Formation.



Figure A6.1. Interbeds of fossiliferous sand from eastern Cypress Hills.

A distinctive suite of gravel lithologies forms the Cypress Hills gravel cap. The predominant rock type is quartzite, which ranges in color from tan to red and is sometimes mottled or banded. Nearly all of the largest rocks are quartzite: 90% of the rocks on top of the western Cypress Hills are quartzite.¹⁰ The quartzite is very hard and well rounded. Abundant percussion marks, circular to semicircular cracks about 3 cm across and 5 mm deep, are found on nearly all of the quartzite cobbles and boulders (see Figure 14.5), few on smaller rocks. The largest rock Klevberg and I found there has a long axis of 15 inches

¹² Vonhof, J.A. 1965. The Cypress Hills Formation and its reworked deposits in southwestern Saskatchewan. *Alberta Society of Petroleum Geologists 15th Annual Field Conference Guidebook*, part I, Calgary, Alberta, Canada, pp. 142–161.

¹³ Crickmay, C.H., 1965. An interpretation of erosional discrepancy, Cypress Hills. *Alberta Society of Petroleum Geologists 15th Annual Field Conference Guidebook*, part I, Calgary, Alberta, Canada, pp. 66–73.

¹⁴ Storer, J.E., 1984. Fossil mammals of the Southfork Local Fauna (early Chadronian) of Saskatchewan. *Canadian Journal of Earth Sciences* 21:1,400–1,405.

(39 cm) and weighs 58 pounds (26 kg).^{15,16} We also observed igneous rocks that most likely were transported from the small mountain ranges to the south or southwest.^{10,17} Minor lithologies are also as well rounded as the quartzites. Nearly all of the rocks exhibit a uniform coating (patina) of iron oxide.

All the lithologies observed, with the exception of the relatively soft Ravenscrag-Frenchman sandstone rocks, are not from local outcrops. Paleocurrent analysis, based on cross-bedded sands and imbrication of oblong rocks, indicates at one time a general current from the west-southwest¹² or the southwest¹⁸ deposited the Cypress Hills gravel (see Figure 14.1). Interestingly, the rocks decrease in average size from west to east, as would be expected if the source was west of the formation. The nearest upcurrent source for the exotic rocks, based on inferred paleocurrent direction and distinctive igneous lithologies, is either the northwestern Rocky Mountains of Montana,¹² 190 miles (300 km) distant from the western edge of the Cypress Hills, or central Idaho, 310 miles (500 km) away.¹⁰

The Cypress Hills are the highest planation surface in the High Plains. Gravel indistinguishable from that of the Cypress Hills is commonly found capping small hills and plateaus east and south of the Cypress Hills² Similar gravel is found below the Cypress Hills plateau and was apparently reworked from the plateau, as the "redeposited Cypress Hills Formation."¹²

Relation to the Swift Current Plateau to the Northeast

The relationship of the predominantly quartzite gravel on the Swift Current Plateau (a low plateau about 45 miles (70 km) east-northeast of the Cypress Hills, see Figure 14.1) to the Cypress Hills gravel has been controversial for some time. The Swift Current Plateau stands only about 100 feet (30 m) above the general level of the land (Figure A6.2). Gravel on the Swift Current Plateau (see Figure 14.6) is indistinguishable from the

¹⁵ Klevberg, P. and M.J. Oard, 1998. Paleohydrology of the Cypress Hills Formation and Flaxville gravel. In, Walsh, R.E. (editor), *Proceedings of the Fourth International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 361–378.

¹⁶ Oard, M.J. and P. Klevberg, 1998. A diluvial interpretation of the Cypress Hills Formation, Flaxville gravels, and related deposits. In, Walsh, R.E. (editor). *Proceedings of the Fourth International Conference on Creationism*, technical symposium sessions, Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 421–436.

¹⁷ Truscott, M.G. 1975. Petrology and geochemistry of igneous rocks of East Butte, Sweetgrass Hills, Montana. Unpublished PhD thesis, University of Saskatchewan, Saskatchewan.

¹⁸ Leckie, D.A., 2006. Tertiary fluvial gravels and evolution of the Western Canadian Prairie landscape. *Sedimentary Geology* 190:139–158.



Figure A6.2. Flat surface of the Swift Current Plateau, southern Saskatchewan.

Cypress Hills Formation.^{19,20} Because fossils are found in the Swift Current Plateau gravel, the plateau was once thought to be older than the Cypress Hills (see Appendix 8). But now, investigators think that the Swift Current Plateau is a low extension of the Cypress Hills plateau toward the east,^{21,22,23} which would not make the fossils the same age. This shows the lack of precision of the evolutionary fossil dating scheme.

¹⁹ Russell, L.S., 1950. The Tertiary gravels of Saskatchewan. *Transactions of the Royal Society of Canada 44* (Series III):51–59.

²⁰ Storer, J.E., 1978. Tertiary sands and gravels in Saskatchewan and Alberta: correlation of mammalian faunas. In, Stelck, C. R. and B. D. E. Chatterton (editors), *Western and Arctic Canadian Biostratigraphy*, Geological Association of Canada Special Paper 18, pp. 595–602.

²¹ Storer, J.E., 1994. A latest Chadronian (late Eocene) mammalian fauna from the Cypress Hills, Saskatchewan. *Canadian Journal of Earth Sciences* 31:1,335–1,341

²² Russell, L.S., 1950. The Tertiary gravels of Saskatchewan. *Transactions of the Royal Society of Canada 44* (Series III):51–59.

²³ Russell, L.S. and R.T.D. Wickenden, 1933. An Upper Eocene Vertebrate Fauna from Saskatchewan. *Transactions of the Royal Society of Canada 27* (Series III):53–65.