Sea, so to generate such high velocity, sustained, unidirectional ocean currents over such a large area would require a mechanism of catastrophic proportions. The only modern analogue would be the severe currents generated during a tsunami, when unidirectional currents exceeding 1 m per second are known to have been sustained for hours while moving large quantities of sand and building huge sand waves in deep water in its waning stages. The recent discovery of recumbent or overturned cross-beds within the Hawkesbury Sandstone has provided convincing evidence that a succession of catastrophic, massive flood waves, possibly as high as 20 m and up to 250 km wide, carried billions of tons of sand at enormous speed and dumped it to form the massive sandstone units.[27] This admission recognizes that the extent and volume of these massive sandstones have no equal or comparison among the sandy sediments deposited by rivers in the present world. The huge volumes and velocities necessary to explain the water and sediment flows to deposit these sandstone beds over these vast areas required catastrophic conditions in the past on a scale not experienced in the present world.

Megasequences of North America

The advent of the seismic reflection method to recognize and delineate strata sequences, and correlate them across and between sedimentary basins, has made it possible to analyze the sedimentation patterns on regional and continental scales. Thus, as a result of the extensive use of the seismic reflection method and the concurrent emphasis on sequence stratigraphy, various orders of strata sequence cycles in the geologic record have been recognized, including continent-wide, unconformity-bounded packages of sedimentary strata known as megasequences. Six such megasequences traceable across North America have been identified, and can be traced from the Cordilleran region in the west to the Appalachian Basin in the east.[28] Recognition of these megasequences is based on physical relationships among the rock units, each megasequence representing a major cycle of transgression and regression.

The first and lowermost of these North American megasequences has been called the Sauk Megasequence. A typical exposure of it occurs in the Grand Canyon, where it is known as the Tonto Group. The Cambrian strata compromising this group are, from the base of the sequence upwards, the Tapeats Sandstone, the Bright Angel Shale, and the Muav Limestone, which represents a fining upwards sequence produced by a transgression.[29] As the ocean waters from the southwest flooded northeastwards onto what had been land, they and their sediment load eroded that land surface as they surged over it. A prograding, fining-upwards

27 J. Woodford, April 30, 1994, Rock doctor catches up with our prehistoric surf, *The Sydney Morning Herald*, 2.

28 L. L. Sloss, 1963, Sequences in the cratonic interior of North America, *Geological Society of American Bulletin*, 74: 93-114.

29 S. A. Austin, A creationist view of Grand Canyon strata, in Austin, 1994, 67-70. Note especially Figure 4.12 on 69.

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sequence of sediments was deposited as the waters flooded further and further inland. The different strata units were deposited side-by-side laterally and stacked vertically at the same time. The result was deposition of the Tapeats Sandstone, Bright Angel Shale, and Muav Limestone contemporaneously to form the Tonto Group over a vast area, separated from the underlying basement rocks by an angular unconformity.

At the base of the sequence where the surging waters were at their fastest, boulders with a diameter of up to 4.5 m and weighing up to 200 tons eroded from the basement strata were carried along by the advancing waters and then deposited at the unconformity.[30] Just above in the water column where the current was not quite as fast, sand was carried landwards to be deposited on top of the basal boulders of the Tapeats Sandstone as the waters transgressed further inland. In the relatively quieter waters oceanward, clay and lime muds were deposited to form the Bright Angel Shale, and Muav Limestone, respectively. The Tapeats Sandstone varies in thickness between 38 and 99 meters, the Bright Angel Shale is between 106 and 122 meters thick, while the Muav Limestone thickens westwards from 106 meters to 305 meters.[31] The majority of the Tapeats Sandstone consists of beds typically less than 1 meter thick, with planar and trough cross-stratification and crudely developed horizontal stratification, features comparable to storm-generated sand beds. Similarly, horizontal laminations, small- to large-scale planar, tabular, and trough cross-stratification, and wavy and lenticular bedding, in the Bright Angel Shale have been described as suggesting "deposition by storm-enhanced currents."[32]

The vertical sequence consisting of the Great Unconformity, Tapeats Sandstone, Bright Angel Shale, and Muav Limestone has enormous horizontal extent, which can be measured in terms of many hundreds of kilometers. However, the Sauk Megasequence, which consists of these Tonto Group strata in the Grand Canyon region, has been traced right across the North American continent, because strata units similar to those which make up the Tonto Group can be correlated with one another over such an enormous lateral extent. Indeed, it is possible to map the occurrence of all the sandstone strata that correlate with the Tapeats Sandstone, which together are known as the basal sandstone lithosome of the Sauk Megasequence. Distribution of this basal sandstone lithosome appears to form a single sandstone body that blankets a major portion of North America, extending along the Mexico border from southern California to Texas northwards across Montana and much of North Dakota through to Canada, and from southern California and Nevada right across to the Mid-West and the New England including Maine (Figure 45, page 1082). As such, this enormous blanket

30 Austin, 1994, 46, Figure 3.23.

31 L. T. Middleton and D. K. Elliott, 2003, Tonto Group, in *Grand Canyon Geology*, 2nd edition, S.S. Beus and M. Morales, ed., New York: Oxford University Press, 90-106.

32 Middleton and Elliot, 2003.

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of sandstone right across North America represents a major flooding of the land, the evidence in the Tapeats Sandstone implying that it was a rapid, storm-driven inundation, such as that which occurred at the initiation of the cataclysmic Flood event.

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