

Among the most important (and interrelated) factors that seem to control landform development are the following: size and density of object, presence of associated star(s), size and intensity of associated star(s), proximity to associated star(s), presence and composition of atmosphere, configuration of orbit, rotational period, tilt of rotational axis, stage of evolution of planetary system and associated star(s), presence of plate tectonics, composition of object, and presence and abundance of life.

**Water as a Public Trust Resource.** Diane O'Connell, Department of Geography, Schoolcraft College, Livonia, MI 48152

The public trust doctrine, which has been described since the time of the Roman Empire, states that certain resources, such as water and air, are so important that they cannot be owned by individuals. Using this doctrine, the government would ensure that these resources can be used by all of the citizens. Application of this doctrine would imply that the nation's navigable water resources should be held by the government for the people, and these resources could not be reallocated or sold for the benefit of individuals. However, water resources are often limited in supply, and legal doctrines defining users have evolved in the states. In the humid east, riparian rights are assigned to users bordering a watercourse. Most western states define water rights using prior appropriation, which has some properties of private ownership. Both of these water rights systems potentially limit the public's right to use water resources, and conflict often occurs over individual versus public rights. Courts frequently decide if the use of the resource should be viewed as a property right, or if it is subject to the public trust. This paper reviews the public trust doctrine, and examines case studies that define water resources as private property or public commodity.

## Geological Sciences

**Deformation in the Spine of the Ada Bible Church Mastodon.** Ryan Bebej and Ralph Stearley, Calvin College, Departments of Biology and Geology & Geography, Grand Rapids, MI 49546

The Ada Bible Church Mastodon was excavated by a Calvin College crew in 1999. During the restoration of this late-age bull mastodon skeleton, bone deformation was noticed in the lower thoracic and lumbar vertebrae. Left anterior and posterior zygapophyses are increased in size and have migrated medially. Right anterior and posterior zygapophyses are reduced in size and often not articulating with their counterpart processes. This has been accompanied by a shift in the base of the spinous processes. Compensating, the dorsal portion of the spinous processes, when viewed dorsally, are torqued counterclockwise. Muscles originating on the lumbodorsal fascia surrounding the spinous processes in this region include the internal and external obliques and the latissimus dorsi. These muscles wrap around the body cavity and support the weight of the internal organs. Morphological changes in the vertebrae resulted from long-term bone remodeling in response to pervasive stress, which we believe was induced by the natural architecture of the mastodon animal.