PONDS, LAKES, AND OCEANS: AN OVERVIEW OF STANDING BODIES OF WATER ON MARS. R. A. De Hon, Department of Geosciences, Northeast Louisiana University, Monroe, LA 71209, USA.

Introduction

Wherever there is a surface flow of water across a previously uneroded surface there will be ponding in closed depressions. Lakes on Mars represent unique geological entities with unique geologic processes which produce distinctive landforms and distinctive sedimentary materials that record the history of the local environment.

Origin of ponds

Ample evidence of water on the surface of Mars is provided by erosional channels and channel related features [1-3]. Large catastrophic outflow channels were carved by overland flows released from either large upland surface impoundments or from subsurface storage. Other overland flows and sapping channels were sustained by subsurface discharge from springs and seeps. Valley networks are cited as possible evidence of rainfall in early martian history.

Ponding of water is a natural consequence of flow across a surface unmodified by previous fluvial processes. Local irregularities in topography become natural traps to store water until they are filled to overflowing. Impoundments ranging from small ephemeral bodies trapped in craters and small depressions [4], large lakes in regional-scale closed basins [5], to ocean-sized bodies flooding the northern lowlands [6, 7].

Landforms

Any topographic basin at the terminus of one or more channel systems is a potential site of ponding of water, as are basins and craters along channels [4] . To verify whether such basins where, in fact, lakes requires recognition of an appropriate channel that could have directed water to the basin as well as some indication that water was held in the basin. Evidence includes: basins situated along outflow courses, smooth plains-forming materials on crater floors, deltas at points of entry into closed basins, and shoreline features [wave cut terraces, bars, tombolos, etc.]. Much of the

materials mapped as smooth plains [8-10] may be lacustrine plains

Significance

Ponds along drainage courses represent temporary storage and retardation of discharge to the mouth of a channel system. Hence, a single release of water may be transformed into a prolonged and episodic outflow near the terminal reaches. As water is impounded, sedimentation occurs by loss of velocity and turbulence. Renewed discharge upon release from impoundment results in renewed erosion down stream from the point of release. The sediment load carried and eventually deposited by channeled flow is derived from materials traversed by the channel below the last site of impoundment. Thus, ponds are local sediment traps that retain the sedimentary record of ponding prior to overflow. Such basins are floored with course sediments in graded bedding which represents the initial filling of the basin. These sediments may be overlain by prograging delta deposits as flow continues to fill the basin or horizontally-bedded, fine-grained material deposited in slack water. Water remaining after drainage of the basin may be a source of evaporitic deposits. Lacustrine deposits tend to be plains-forming materials that bury subjacent features. These materials may blanket topographic irregularities beneath the water; otherwise, they tend to produce flat, level plains. Lacustrine plains are some of the flattest, most featureless surfaces on the earth. Ponds, large and small, are ideal sites for the blossoming of life forms as well as for preservation of evidence of those lifeforms.

Age and Lifetime

Although water is scarce now, channels of widely divergent ages indicate that water was present throughout much of the geologic history of the planet. The climate history of Mars is poorly understood, and estimates of the maximum amount of water present on the surface at any one time varies considerably from the equivalent of a few meters [11] to several hundred meters planet-wide [7]. Presumably a wetter, warmer climate allowed for the presence of standing water and the formation of an ocean that flooded the northern lowlands. Local ponding in some outflow channels is estimated to exist for only short periods of time [12] but longer lifetimes are proposed for large bodies such as the ocean and perhaps for remnant ponds in partially-drained lake basins. The lifetime of standing bodies of water is controlled by residual water supply from inflow channels, infiltration rates, effluent seepage rates, and evaporation rate into the atmosphere.

Conclusion

There is little doubt that short-term lakes existed on the surface of Mars. It remains for high resolution imaging to detect subtle strandline features; for remote geochemical and surface

studies to identify unequivocal lake sediments such as clays, carbonates, sulfates or other evaporitic minerals; and for on-site stratigraphic studies to decipher depositional history. Paleolakes are significant objects of study because they--provide smooth, safe landing sites preserve sedimentary history represent candidate sites for preservation of ancient martian life.

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