MEGAGEOMORPHOLOGY: MARS VIS A VIS EARTH

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The following comments are based largely on Mars vis-a-vis Earth. Personal knowledge of Moon, Venus, Mercury and other solar system bodies is too scanty for them to be included herein.

Outrageous Hypotheses

One of the greatest benefits of the planetary exploration program could be to blast us out of intellectual ruts, forcing consideration or reconsideration of different, unusual, even seemingly outrageous explanations for puzzling natural phenomena.

The areas of chaotic terrain, the giant chasma of the Valles Marineris region, the complex linear and circular depressions of Labyrinthus Noctis on Mars all suggest the possibility of large-scale collapse of parts of the martian crust within equatorial and sub-equatorial latitudes. It seems generally accepted that the above features are fossil, being perhaps, more than a billion years old. Is it possible that parts of Earth's crust experienced similar episodes of large-scale collapse sometime early in the evolution of the planet?

We may have failed to recognize features created by regional collapse simply because of their scale or more likely because of alteration and obscuration by metamorphism, erosion, weathering, and burial, or any combination of those processes. It is difficult to find something if you don't know what you are looking for, lost car keys or trilobite fragments for example. What would a billion- year old area of chaotic terrain look like on Earth? Like the assemblage of rocks and structures constituting some terrestrial metamorphic complexes, for instance? Do some of our thick, multikilometer, localized accumulations of sedimentary rocks occupy ancient collapsed chasma? Does the seemingly nonsensical distribution of lithological units within some ancient complex rock terranes make sense if viewed in the pattern of martian labyrinth features?

An even more fundamental problem is the possible cause of large-scale regional collapse. On Mars deterioration of massive bodies of ground ice or the migration of magma from one area to another, to create gigantic volcanic constructs, have been proposed. Perhaps, it is time we looked again at the possibility of planetary expansion for both Mars and Earth. This old idea has not been generally welcomed to the banquet table by a majority of earth scientists, although vigorously sponsored by some, because of a seeming lack of adequate energy sources to produce significant expansion. Some of the discrediting calculations, however, have been made for an axial expansion of 1000 km, which seems an excessive requirement, or may not have looked far enough back into planetary history.

Planetary expansion might logically be expected to produce planet-wide manifestations. On Mars, visible surface features of collapse are located in equatorial and sub-equatorial areas, they are not planet-wide. Since both martian polar and subpolar regions, especially the north appear to have been sites of extensive deposition, collapse features there might be buried. It seems more likely, however, that martian collapse was actually equatorial in distribution. This makes one wonder if equatorial expansion of Mars may have involved a change in the figure of the planet rather than over-all expansion. An increase in oblateness of the spheroid, owing to an increase in rate of planetary rotation, could cause equatorial expansion in a latitudinal direction, a decrease in rotation rate would presumably result in longitudinal extension. An increase in rotational rate might have been caused by heavier elements settling to the core during planetary differentiation, but possible causes of a decrease are more speculative. Irregular distribution of martian collapse features within the equatorial region could reflect inhomogeneities of crustal and subcrustal materials. If Mars suffered a change in its spheroid because of a change in rotational rate, why not also Earth, albeit perhaps earlier in its history?

Scale

The message from Mars in terms of surface features and relationships is "Think big." Many of the landslides, flood-scoured channels, valleys, chasms, labrinths, volcanoes, polygonal structures, collapse areas, rock streams, sand dunes, eolian deflated features, and other forms and relationships displayed on the martian surface are gigantic by Earth standards. This maybe, in part, a matter of viewing distance, commonly around 1000 km on Mars and only a fraction of that on Earth. More likely it is the result of the effective erasing and obscuring processes operating on Earth, weathering, erosion, and deposition, which allow us to see only the youngest features. By terrestrial temporal standards, much martian topography is fossil, the product of bygone processes and conditions. Could Earth once have had features of a size corresponding to those seen on Mars but now so modified by secondary surface processes to be overlooked?

If so, is it possible that relationships created by those features, mega-scars so to speak, could be identified or recognized by extreme remote sensing of Earth's surface? Further, are they worth looking for? The answer must assuredly be yes, for the unknown is always worth exploring. Mega-features of Earth's surface and crust already recognized and interpreted as the product of currently favored models, plate tectonics for example, might more satisfactorily be accounted for by some other model derived from the concept of large, fossil features developed perhaps by collapse of parts of the crust on a scale comparable to that seen on Mars.

Genetic Processes

The processes of obscuration are so effective on Earth that we usually see or recognize only a part of the total work done by some particular genetic activity. This is a differential matter, and certain genetic processes are more suppressed or obscured than others. Features on the surface of Mars suggest that mass movements, wind, and ground-water (or ground-ice) sapping deserve more consideration than normally given in the creation of terrestrial landscapes. Wind is recognized as effective in local and special terrestrial settings, but it is possibly underrated in terrains of regional extent, except, in areas of extreme aridity. Features of the martian surface strongly suggest that wind is effective regionally, as well as locally, and should be factored into considerations of regional landscapes.

Many forms of mass movement are subtle and easily obscured by more vigorous and rapidly operating processes to the extent that the true contribution of mass movements is not recognized. On Mars, where the obscuring and competing processes are weaker, it is clear that mass movements of various types, including creep, slides, and collapse, have played a truly major role in landscape evolution.

Thanks to large and extensive features, widely distributed on the surface of Mars, that appear to have been created by sapping, this much neglected and overlooked process is now getting considerable well-deserved attention from terrestrial geomorphologists. The role of sapping in creating landforms merits further nourishment and cultivation.

Catstrophies

Thanks, in part, to the opportunity for viewing of other planetary surfaces where fossil forms are preserved more fully than on Earth, terrestrial geomorphologists and planetary scientists have become more sensitive to the role and importance of catastrophies in creating landscape features. This is a healthy trend which deserves encouragement.

Remote Sensing and Data Treatment

I suspect we have not yet succeeded in bringing into full play all the techniques, equipment, knowledge, and tallents currently available for remote sensing of Earth's surface. Astronomers, astrophysicists, and planetary scientists may be doing a better job in that regard on distant planetary bodies. We should be able to measure more precisely and more fully the spectra of radiations emitted from Earth's surface.

Just as fruitful might be a more exhaustive processing of remote sensing data already on hand. Anyone who looked at the seemingly blank photos of Mars first returned by the Mariner 4 flyby, and then compared them with the final computer-enhanced product revealing a heavily crater martian surface understands the potential of these methods. Are we perhaps sitting on a mine dump of valuable ore which has not been fully analysed?