appeared on 8th Jun 2008

Mountains' growing pains

Mountains have been found to grow in spurts and starts, says S. Ananthanarayanan.

The theory of the growth of mountain ranges centers around ***plate tectonics***, or portions of the crust of the earth ramming into neighbouring portions. But the understanding of how mountains rise when this happens has get refined by a detailed biography that has recently been pieced together for the Andes, South America.

Plate Tectonics

The outermost layer of the earth is called the crust, and just below the crust is the ***mantle***. The crust and the upper part of the mantle are considered together and are called the ***lithosphere***, so called to say that it is ***rocky***. The layer below the lithosphere is called the ***asthenosphere***, a region between 100 to 200 kms below the surface. This part is not entirely solid rock and is somewhat viscous, or flowing like a thick liquid. It gets its name, in fact from ***sthenes***, which means ***without strength***, in Greek.

The lithosphere, perched on a somewhat pliable base, can then move and shift, under the effect old or new forces, dating from the time of formation or arising from hot spots, or mantle plumes, which are streams of heat rising from the deep, core-mantle boundary. It is these movements that are thought to have resulted in great masses of the crust having moved and created the continents as we know them today.

Collision of plates

The lithosphere, or the rocky outer portion, has a structure somewhat like plates stacked one on the other, perhaps representing stages of formation. The plates are then constantly in the process of getting into more stable positions, and the disturbances that occur, when the plates suddenly adjust, are perceived as earthquakes, some minor, some cataclysmic. In addition, a system of plates may be in motion over the asthenosphere and plates may collide with other stationary or moving masses.

It is such a collision that the 'squeezing' of material is thought to result in buckle, the upward buckling seen as mountains. Along with the rising of material as a mountain range, there is bucking that goes below and a heavy, high density ***root*** is formed, which holds the crust down, in a way, like an ***anchor***. This lower, root part is gradually eroded due to currents in the mantle. Erosion of the root amount to reducing load of the root, and the mountain range rises, till the material in the root thickens and becomes rigid.

The new finding

Carmala Garzione of the University of Rochester and associates, including Prosenjiot Ghosh at the Indian Institute of Science, Bengaluru, developed a detailed record of the altitude of the

Andes during the last tens of millions of years. The team used currently developed methods by which the temperature and rainfall can be determined from the chemical composition of the soil at a place. By studying the sedimentary basin in the Andes, then, the team could determine at what times and at what altitudes the sediments arose. The findings revealed that the Andes grew steadily for millions of years, but suddenly lifted at a much faster pace, starting ten million to six million years ago.

This fast spurt in growth is not in keeping with the current theory of plate tectonics and mountain growth. Taking into account different other findings in the history of folding, faulting and volcanic activity, it becomes necessary to include a phenomenon of ***delamination***, or the smooth movement of the different layers breaking down. This results in heating of the root and the material becomes viscous and forms a spherical drop, like a drop of treacle, which disconnects and falls. The release of the load leads to the mountains above rising fast and high, as is observed!!