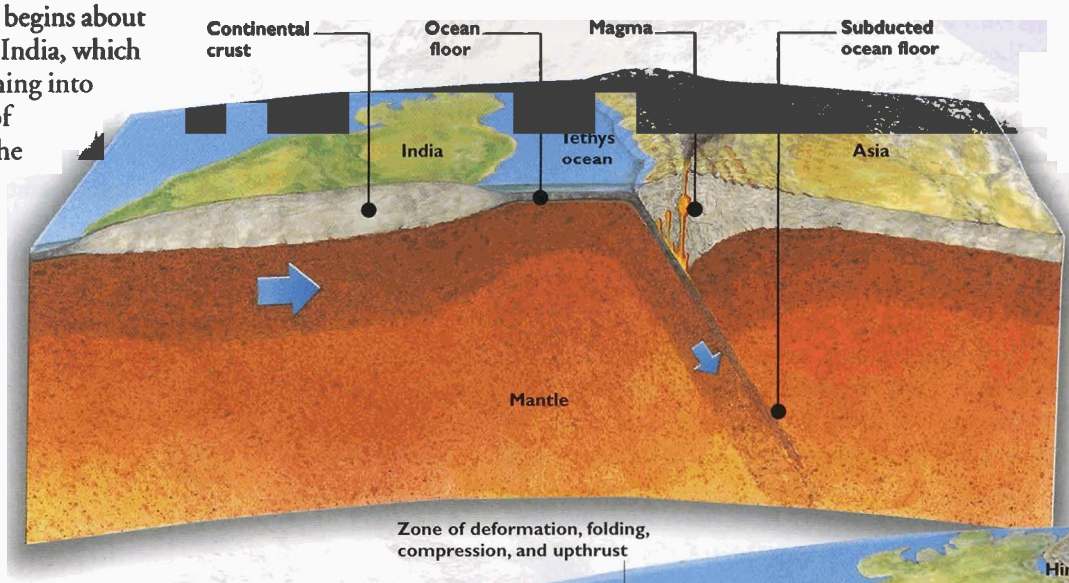
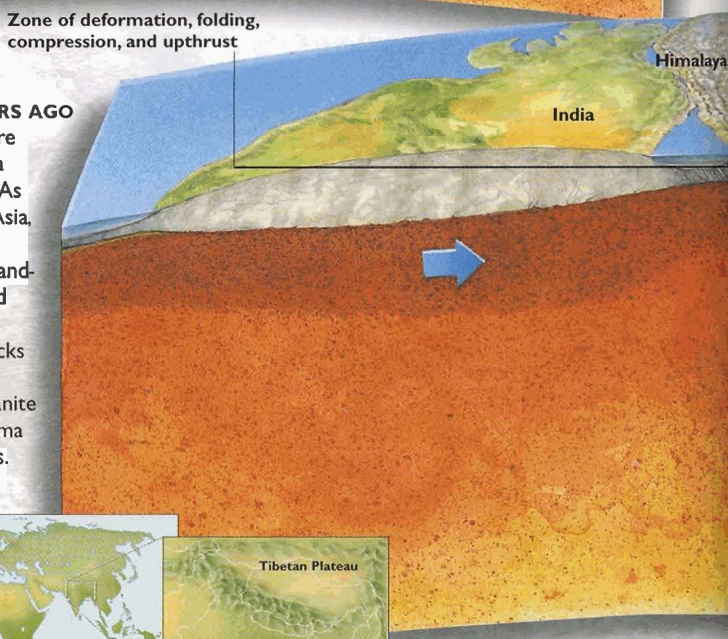
The Himalayas and the Tibetan Plateau

THE STORY OF HOW THE HIMALAYAS AND THE Tibetan plateau were created begins about 55 million years ago. At the time, India, which was a separate landmass, was crashing into the continent of Asia. The point of collision formed the Himalayas, the highest and youngest mountain range in the world. It also formed the Tibetan plateau, the largest upland region on Earth, which is on average 3 miles (5 kilometers) above sea level. For this reason it is known as the "roof of the world." The rock (called the continental crust) beneath Tibet is an astonishing 46 miles (74 kilometers) thick, about twice the average crustal thickness.

THE FORMATION OF THE HIMALAYAS





MOUNTAIN-BUILDING MECHANICS

The mechanism by which mountains are formed has long been understood. As two continents collide, enormous forces are exerted on the rock at the point of impact, crumpling, folding, compressing, deforming, and altering its chemical composition. Some of the rock is pushed skyward to form the peaks of the mountains, while other rock is pushed deep down into the Earth's mantle to form the "roots" of the mountains. A mountain range such as the Himalayas is, in effect, the thickening of the crust caused by rocks being pushed both upward and downward.

In addition, the rock of the deep mantle is denser than the rock of the crust above it. As the crust thickens, the mantle effectively buoys up the line of mountains. As the mountains get bigger, this mantle support increases and the entire mountain range is pushed skyward. This elevation

55 MILLION YEARS AGO
The Himalayas were created when India collided with Asia. As India approached Asia, the ocean floor in between the two landmasses was pushed down (subducted) under Asia. The rocks melted, and either cooled to form granite or escaped as magma through volcanoes.

MOUNTAIN PEAKS
Annapurna is just one of many peaks in the Himalayas that rise over 5 miles (8 kilometers) above sea level. These peaks are still being uplifted by some 4 inches (10 centimeters) a century and eroded at the same rate, with the debris carried away by great rivers, such as the Ganges.

DEFYING GRAVITY

The Tibetan plateau covers some 2 million square miles (5 million square kilometers) of Asia, and the remarkable uniformity of its elevation, at about 3 miles (5 kilometers) above sea level, suggests that this may be the maximum possible height at which rocks in the Earth's crust can be supported over such a large surface area. Any further thickening would put such pressure on the rocks deep in the base of the plateau that they would melt and shift.

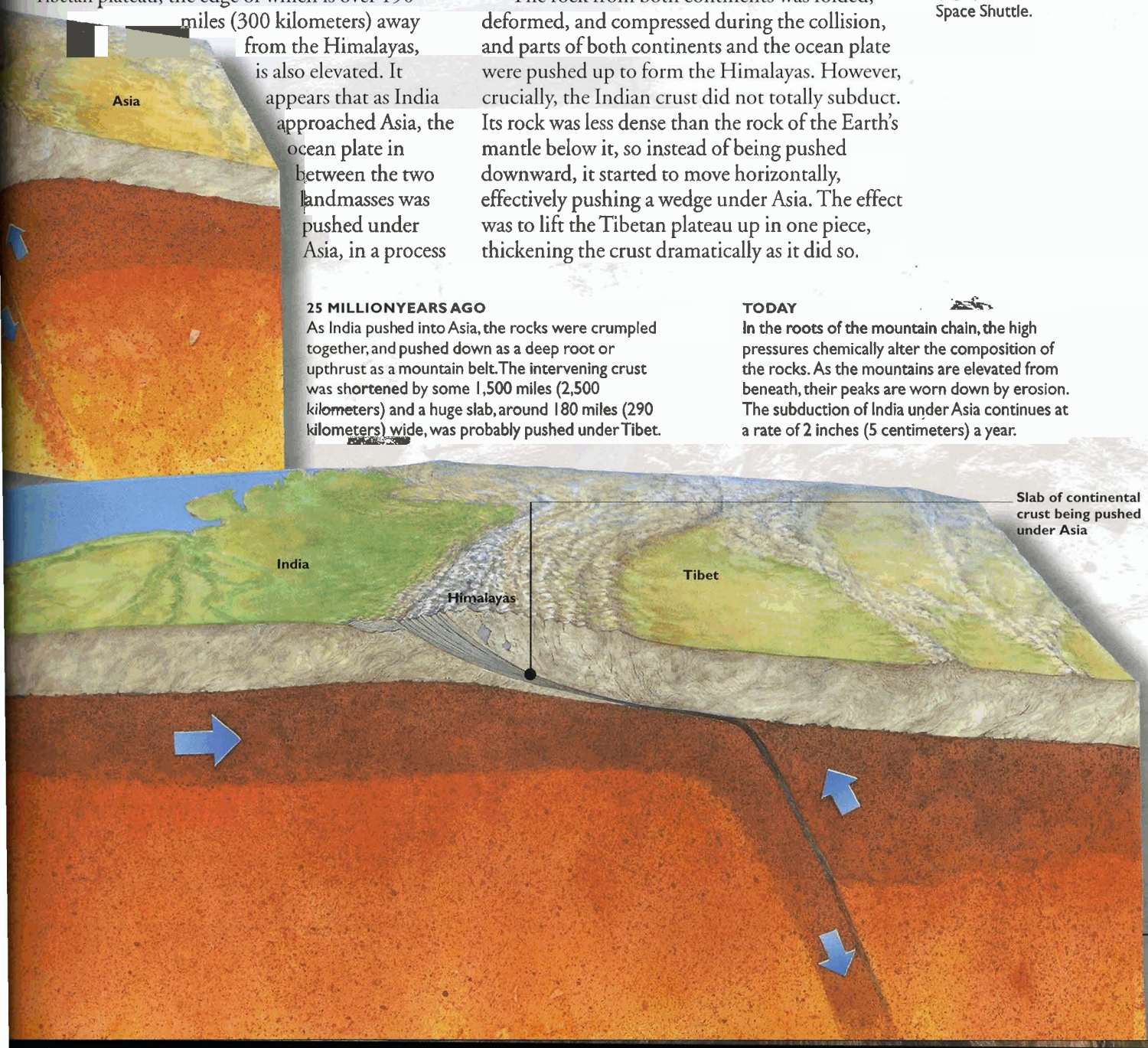
ROOF OF THE WORLD
A view of the floodplain of the Ganges River (left), the snow-covered Himalayas, and the Tibetan plateau (right), as seen from a NASA Space Shuttle.

is counterbalanced, however, by the erosive action of the weather, which continuously strips off the top layer of the mountain peaks.

BUILDING THE TIBETAN PLATEAU

While this model explains the origin of most mountain ranges, it does not explain why the Tibetan plateau, the edge of which is over 190 miles (300 kilometers) away from the Himalayas, is also elevated. It appears that as India approached Asia, the ocean plate in between the two landmasses was pushed under Asia, in a process called subduction. As the two continents collided, part of the landmass of India was also subducted, following the ocean crust down into the mantle. The edge of Asia was pushed over the top of India.

The rock from both continents was folded, deformed, and compressed during the collision, and parts of both continents and the ocean plate were pushed up to form the Himalayas. However, crucially, the Indian crust did not totally subduct. Its rock was less dense than the rock of the Earth's mantle below it, so instead of being pushed downward, it started to move horizontally, effectively pushing a wedge under Asia. The effect was to lift the Tibetan plateau up in one piece, thickening the crust dramatically as it did so.



25 MILLION YEARS AGO
As India pushed into Asia, the rocks were crumpled together, and pushed down as a deep root or upthrust as a mountain belt. The intervening crust was shortened by some 1,500 miles (2,500 kilometers) and a huge slab, around 180 miles (290 kilometers) wide, was probably pushed under Tibet.

TODAY
In the roots of the mountain chain, the high pressures chemically alter the composition of the rocks. As the mountains are elevated from beneath, their peaks are worn down by erosion. The subduction of India under Asia continues at a rate of 2 inches (5 centimeters) a year.