Journal of the Biblical Creation Trust. 2022, Volume 4, pages 14-21

The origin of the mountains: a creationist perspective

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ABSTRACT

The theory of plate tectonics is used by secular and creationist geoscientists to explain the global distribution of mountain belts and their associated deformational structures. Contrary to secular beliefs, creationist geologists have biblical and geological reasons to suppose that mountain formation (orogeny) began during the time of Noah's Flood. Mountains rose quickly because tectonic processes operated at a greater magnitude and intensity than they do today – creationists call this catastrophic plate tectonics (CPT) theory.

During the Flood, large-scale deformation of the Earth's oceanic and continental crust occurred, accompanied by continent-wide deposition of large volumes of sediment that had been eroded by the floodwaters. Both of these processes caused crustal thickening. As soon as the horizontal plate movements slowed during the Flood, regions that had experienced crustal thickening responded to their state of isostatic disequilibrium by rising rapidly, at a rate far quicker than they rise today. Ollier and Pain (2000) found that nearly every mountain range experienced massive uplift in the Pliocene-Pleistocene. The timing of this synchronised uplift is difficult to explain from a uniformitarian perspective, but the creationist theory of CPT is able to explain the origin and timing of global orogeny.

Figure 1. An example of how rocks are deformed in mountain belts, from the Sun River region of Montana, USA. Here, the Lower Carboniferous Madison Limestone is repeated by thrust faulting. The white limestone layer can be seen in the foreground, thinning out in the distance. But it also forms the bluffs in the upper right corner and top of the picture. A low-angle thrust fault associated with mountain-building has caused part of the limestone layer to be thrust over the top of another part, so that the layer appears twice in the rock succession. Photograph by Qfl247 / CC BY-SA 3.0.

INTRODUCTION

For centuries, geologists have been studying areas of high elevation where structural deformation and compositional change is visible. The set of processes that deform and uplift these mountain belts is known as orogeny; the belts themselves are known as orogens. The deformational and compositional structures found in these uplifted areas suggest that the Earth has not always looked the way that it does today. The structure, distribution and composition of orogens can provide insights into the events that have shaped the surface of the Earth throughout time.

THE PRINCIPLES OF STRATIGRAPHY

According to the governing principles of stratigraphy, rock layers are usually laid down in horizontal layers (strata) one on top of the other, with the oldest at the bottom and the youngest at the top. However, this is not how rock layers are usually found in mountainous areas. Mountainous regions (orogens) are usually a jumbled mess of the original strata, containing deformational structures in the form of faults, folds, volcanic intrusions and erosional surfaces (Figure 1). Early on in the study of geology, Nicolas Steno identified that mountainous regions did not accord with the natural principles of stratigraphy and must have been subject to forces that caused deformation in the past (Williams 1973). However, at the time, the driving force that caused this deformation was not known.

THE HISTORY OF PLATE TECTONICS THEORY

In 1858 Antonio Snider-Pellegrini saw that the landmasses on either side of the Atlantic Ocean seemed to fit together like two pieces of a jigsaw puzzle. He proposed that these landmasses had been split apart during Noah's Flood, causing large-scale deformation at the Earth's surface (such as mountain ranges). He based his theory on biblical and geological data (Austin et al. 1994). Although his theory was largely ignored, Snider-Pellegrini was one of the first to suggest some of the basic principles of the plate tectonics theory.

Later on, German meteorologist Alfred Wegener's theory of 'continental drift' incorporated uniformitarian thinking into Snider-Pellegrini's model. He claimed that the continents moved very slowly over millions of years to come to their present arrangement. However, he also lacked an explanation as to the mechanism behind the movements.

In the 1960s an underwater mountain chain was discovered beneath every ocean. It was soon realized that the ocean floor was pulling apart at the centre of these subsea mountains, while molten material was rising from beneath to create new ocean floor. This discovery led Princeton professor Harry Hess to propose that seafloor spreading was the driving mechanism behind the splitting apart of the continents (Hess 1962).

Since the 1960s, even more evidence has accumulated, and the paradigm of plate tectonics has been widely established and accepted in the geosciences. A foundational principle of plate tectonics is that the Earth is comprised of oceanic crust (made of dense material) and continental crust (made of lighter material). The crust and uppermost mantle (called lithosphere) is divided into a series of plates that float on top of a layer of hot rock called the mantle (Figure 2). These plates are on average about 100 kilometres thick and are moving horizontally on top of a ductile layer called the asthenosphere. This 200-kilometre-thick zone behaves in a plastic fashion due to high temperatures and pressures in the upper mantle but is still largely a solid. The asthenosphere allows the plates to move horizontally overtop, most likely propelled by slab pull into the subduction zones. This horizontal plate motion has great explanatory power for many geological structures present on Earth, including orogens.

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PLATE TECTONICS AND OROGENY

For the most part, mountain belts are concentrated along plate boundaries (Figure 3). As tectonic plates interact, the forces acting upon the Earth's crust produce geological scars on the Earth's surface that remain visible

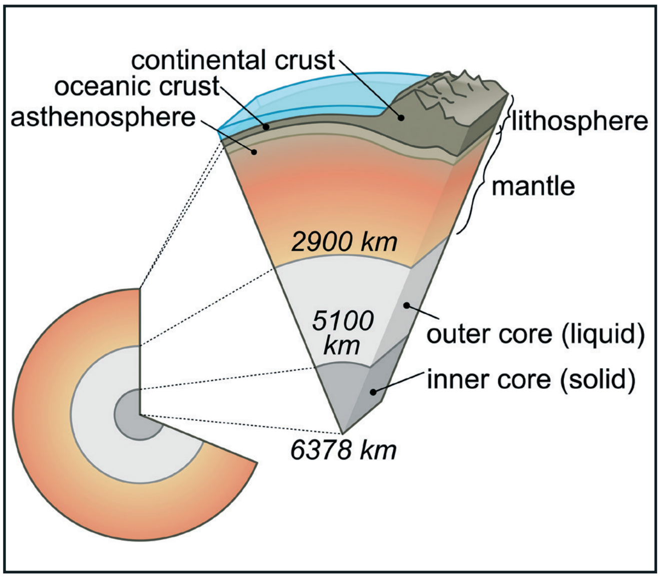

Figure 2. The internal structure of the Earth, showing the core, mantle and crust. The Earth's lithospheric plates comprise the crust and the uppermost part of the mantle. Image by USGS modified by Srimadhav / public domain.

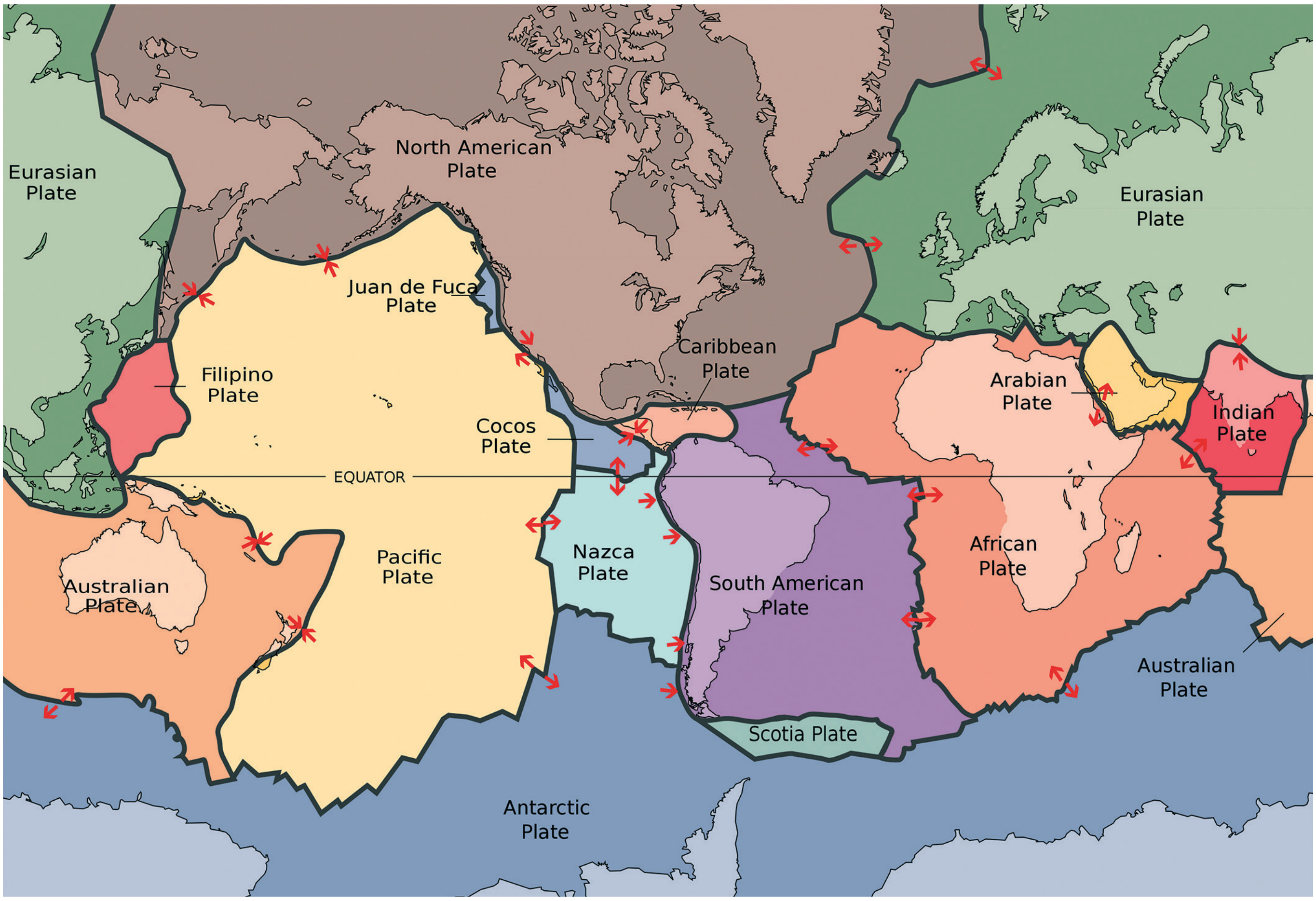

Figure 3. Map showing the Earth's principal tectonic plates. Most geological activity, including earthquakes, volcanoes and mountain-building processes, is focused along the boundaries between these tectonic plates. Red arrows indicate the direction of movement of the plates. Image by USGS / public domain.

unless they are eroded away. There are four types of plate boundaries where orogeny takes place: divergent (plates move apart as in seafloor spreading); convergent (one plate subducts beneath another and plunges into the mantle beneath); collisional (two plates of the same density collide, compressing and raising the material at the boundary); and transform (plates slide past one another). Each type of plate boundary produces its own unique structures that can be used to identify the past and present tectonic environments of both active orogens (areas continuing to experience vertical displacement) and inactive orogens (areas which contain typical orogenic structures, such as volcanic arcs and oceanic plateaus, that are no longer situated on an active plate margin) (Van Der Pluijm and Marshak 2004, p.503).

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THE SECULAR VIEW OF PLATE TECTONICS

The majority of secular and creationist scientists have accepted the theory of plate tectonics due to its explanatory power (Snelling and Hodge 2009). However, they differ in their beliefs about the rate at which these plate movements have occurred in the past. By the time plate tectonics was accepted, an old Earth had already become dogma for the secular scientific community. The time scale of millions of years of geological history was integrated into the theory of plate tectonics, extrapolating the slow and steady movements of today's tectonic plates into the past. However, the long ages do not fit with the evidence in the geological record that suggests that today's mountain ranges experienced a pulse of vertical uplift due to rapidly moving tectonic plates (Baumgardner 2005).

THE CREATIONIST VIEW: CATASTROPHIC PLATE TECTONICS

There is biblical and geological evidence that the rates of today's tectonic processes are a fraction of what they once were in the past. This has led creationists to affirm the theory of catastrophic plate tectonics (CPT). This theory is similar to conventional plate tectonics theory; however, it accounts for rapid plate tectonics occurring during the year of Noah's Flood (Figure 4).

Many creationists think that there is sufficient

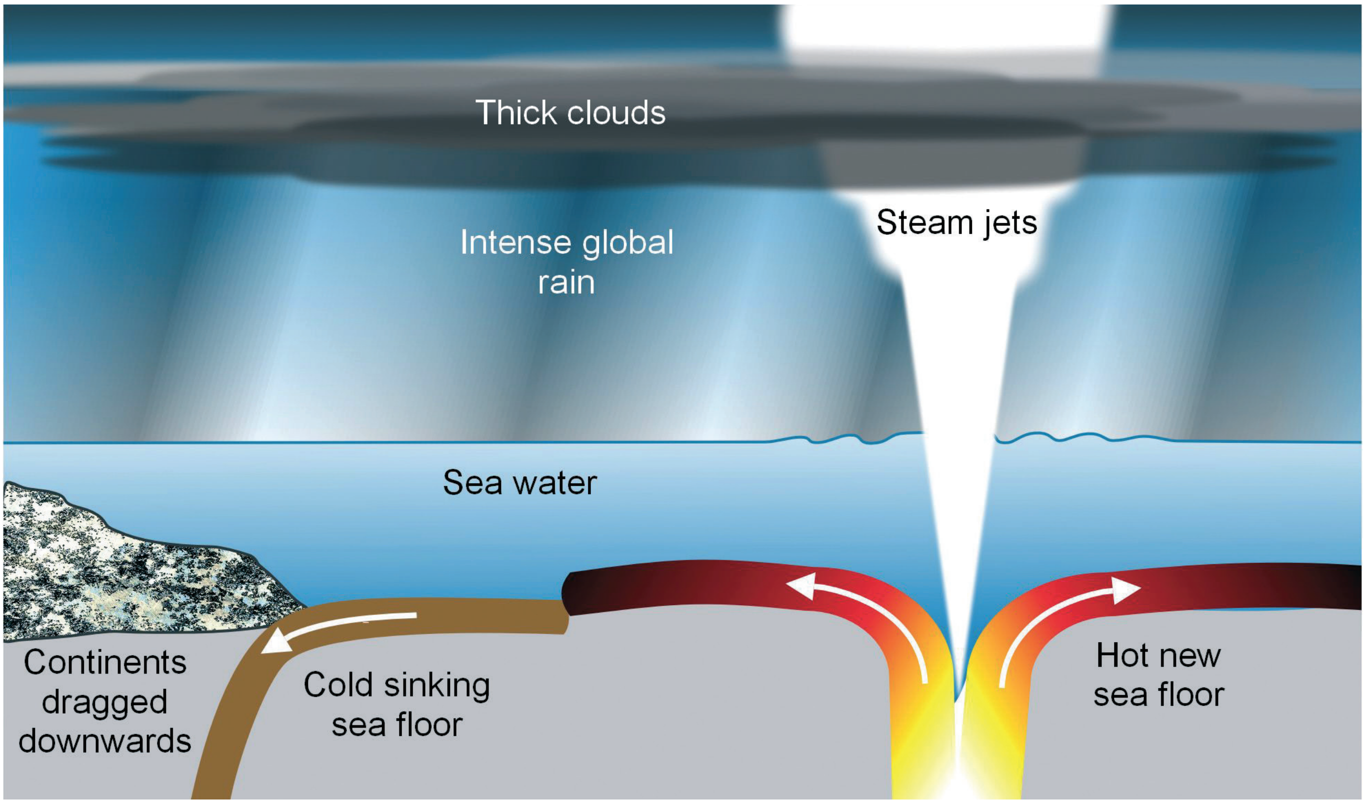

Figure 4. A summary of the catastrophic plate tectonics model. During the Flood, the cool pre-Flood ocean crust was replaced by warmer material from the Earth's mantle. This caused the ocean floor to expand and rise, displacing sea-water onto the continents. The oceans also boiled, propelling water vapour high into the atmosphere which fell as an intense global rain. Image by Jack Lewis / Biblical Creation Trust.

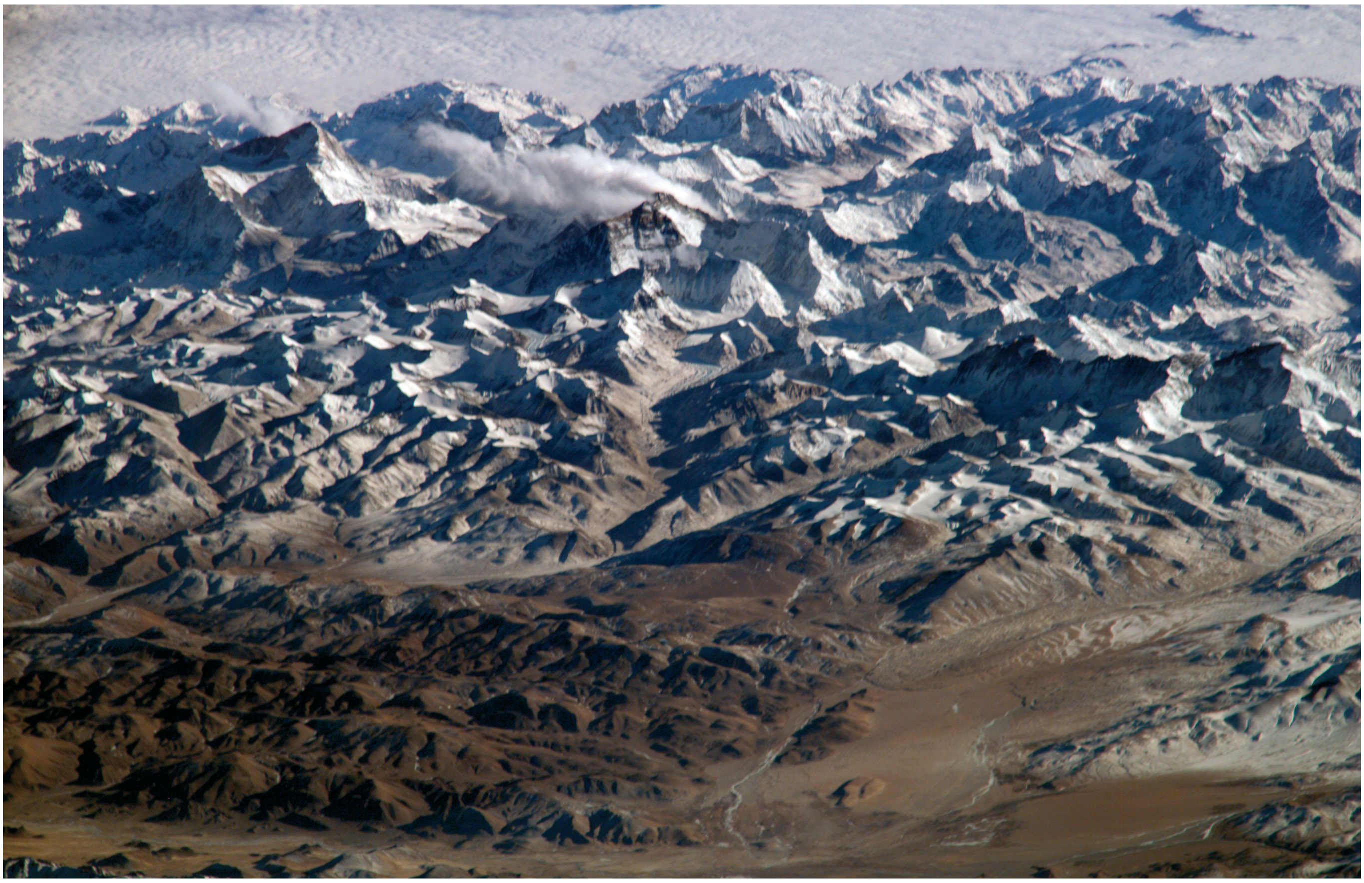

Figure 5. The Himalayan mountain range, looking south from over the Tibetan Plateau, in an image taken by astronauts aboard the International Space Station. Photograph by NASA / public domain.

geological evidence to suggest that the world before the Flood consisted of a single supercontinent, similar to the secular idea of Pangaea (Snelling 2014; Clarey and Werner 2018). Creationists believe that this pre-Flood world was torn apart during the catastrophic events of the Flood. The 'fountains of the great deep' could refer to the initiation of seafloor spreading at the mid-ocean ridges (Austin et al. 1994). In turn, the denser oceanic lithosphere would be pulled under the lighter continental crust at convergent plate boundaries.

Baumgardner (2003) outlines how this global subduction event could turn into a process called 'runaway subduction'. Gravitational potential energy acting on miles of subducting oceanic lithosphere would be released as heat, resulting in further weakening and deformation and thus causing the subducting slab to accelerate and generate more heat, in this way creating a positive feedback. Runaway subduction would have caused the original ocean lithosphere to be moved into the mantle like a conveyor belt, at metres per second, destroying the ocean floor while simultaneously replacing it with material rising from the mantle at the ocean ridges. It also acted as the driving force behind the rapid horizontal movement of tectonic plates. This process would have reconfigured the continents into their present positions within the time frame of the Flood (Baumgardner 1994). Eventually the old, dense ocean lithosphere was completely subducted into the mantle beneath, leaving behind only the new, warmer ocean crust in its place. This warmer, more buoyant material could not be subducted easily, therefore runaway subduction ceased and was replaced by slower rates of subduction that are more representative of today's rates (Clarey 2020a; Navarro 2021).

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Indications that runaway subduction has taken place have been preserved in superfaults containing pseudotachylyte. This glassy material is associated with frictional melting at high temperatures during high-velocity rock movements on fault surfaces – conditions that would accompany rapid subduction (Clarey et al. 2013). More evidence of quickly subducting oceanic crust is found deep within the mantle. Large slabs of cold material have been located near the mantle-core boundary (Clarey 2020b). It is a mystery to secular geophysicists how these slabs of cold rock have made it so deep into the mantle (a process which the conventional plate tectonics model would predict to have taken 50–100 million years, by which time it would have melted away) (Baumgardner 2013). Creationists suppose that these slabs are the remnants of the oceanic crust that rapidly subducted during the time of the Flood and penetrated deep into the mantle. They have remained cold because they have only been in the mantle for a relatively short period of time (Clarey 2020b).

So, you may ask 'what does runaway subduction and CPT have to do with the origin of mountains?' Well, interestingly there is convincing evidence to suggest that today's mountain belts have been formed and rose rapidly as a consequence of these processes (Austin et al. 1994).

GLOBAL RAPID UPLIFT OF MOUNTAIN BELTS

The rapid, synchronised timing of the uplift of today's mountain ranges in the Pliocene is a puzzle to conventional geologists (Ollier and Pain 2000). Even according to their own time scale, the presence of such high mountain belts suggests that their vertical movement outran the erosional processes that should have destroyed them as they rose. The geological record shows that mountain ranges, such as the Himalayas (Figure 5), have risen several kilometres in under five million years according to conventional dating (Baumgardner 2005). This far exceeds the rate at which they are rising today.

Creationist geophysicists are not baffled at the rapid uplift of today's mountains. According to the creationist paradigm the mountains rose rapidly in elevation due to the termination of runaway subduction and CPT. Local increases in crustal thickness caused these areas to experience isostatic uplift rapidly and simultaneously when runaway subduction ceased (Baumgardner 2003).

CRUSTAL THICKENING

The Flood event thickened the crust in a number of ways. First, sediments were redistributed as the Flood waters tore up rock from the continents and ocean floor

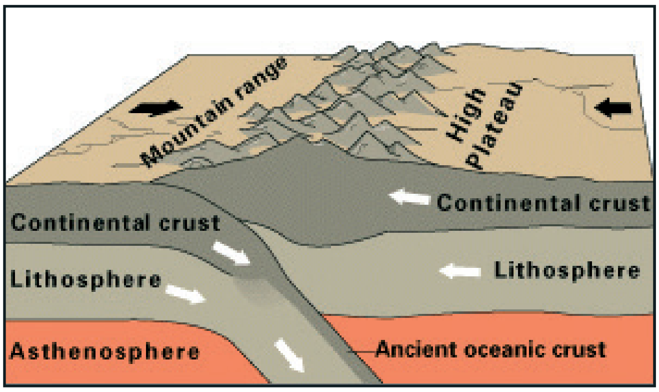

Figure 6. Crustal thickening occurs at destructive plate boundaries, where continents on either side of a subducting ocean collide. Mountain ranges such as the Himalayas formed in this way. Image by USGS / public domain.

and deposited them in concentrated areas on the continents. These deposits were piled on top of a global erosional surface (the Great Unconformity), representing the start of the transgression of the floodwaters onto the continents. Thousands of feet of fossil-bearing sediments are found in areas where high mountain belts exist today, such as the Rockies and Appalachians (McQueen 1986; Austin et al. 1994; Baumgardner 2005).

A second cause of crustal thickening is a process called underplating. As the ocean lithosphere subducts, it experiences partial melting. The melted material rises and joins the underbelly of the continental crust above. This causes the thickness of the continental crust to increase. This igneous material, once cooled and solidified, forms the granitic cores of many mountain belts such as the Sierra Nevada Mountains in California. Sometimes the overlying rock has been eroded away, exposing the igneous cores at the Earth's surface, such as Mount Kinabalu in Borneo (Clarey 2020a).

late in the Flood … CPT and runaway subduction were recycling oceanic crust into the mantle at a speed of metres per second.

A further cause of crustal thickening is compressional deformation of soft rock at subduction zones (Van der Pluijm and Marshak 2004, pp.420-428). Mountain belts occur along convergent plate margins where the ocean lithosphere subducts beneath the continental crust. During CPT, as the oceanic plate rapidly subducted, it pulled the edge of the continental plate downward to form a deep ocean trench. These are found all around the world at most convergent plate margins. Material on the ocean floor was scraped off by the overriding continental crust, creating a wedge of sedimentary and volcanic material in the trench. Some of the former ocean sediment became accreted to the edge of many of the continents in this process, adding to the thickness of the continental crust. Further inland, about 100–150 kilometres above the down-going slab, volcanic arcs formed as a result of the partial melting of the oceanic lithosphere in the mantle. There is rife evidence of grand volcanic explosions in Earth's history due to these volcanoes. Such volcanism would be expected, especially late in the Flood as CPT and runaway subduction were recycling oceanic crust into the mantle at a speed of metres per second (Austin et al. 1994).

Finally, at collisional plate boundaries bringing continental lithosphere against continental lithosphere, the crust would have thickened due to the collisional deformation (Figure 6). Mountain belts, such as the Himalayas, have formed when continents on either side of a closing (subducting) ocean have collided as the oceanic lithosphere completely subducted into the mantle. Collisional tectonics can also extend the continental crust deeper into the mantle until it reaches a critical depth where it can no longer withstand the heat, and melts.

Under the conditions of CPT, the speed at which landmasses collided due to rapid horizontal tectonics would produce large-scale collisional deformation structures, such as those observed today in inland mountain belts such as the Urals. Uplifts and accompanying vibrations from earthquakes would facilitate tectonic landforms on massive scales, such as large landslide debris and gravity-driven overthrust faults. These structures can be observed today and are better explained by CPT than by slow, gradual collisional tectonics (Clarey 2013).

SYNCHRONISED ISOSTATIC UPLIFT

Areas where the crust had been thickened during the Flood rose sharply in elevation due to isostatic disequilibrium when horizontal plate tectonics shut down (Austin et al. 1994). The geological record suggests that the isostatic response of today's mountain ranges was a globally synchronised event that occurred near the end of the Flood. The synchronous timing of this uplift was due to an abrupt halt in the horizontal plate movements associated with CPT (Clarey 2020a). As CPT slowed, the Earth's now thickened crust was given the chance to equilibrate. All the regions of the continents that had been thickened responded by rapidly rising in elevation, for the same reason a floating ice cube pops up out of water immediately if held under water and released. Many mountain ranges are still experiencing vertical uplift in response to the catastrophic events that occurred during the Flood.

CONCLUSION

Plate tectonics theory has vast explanatory power when it comes to the orogenic structures found on the surface of the Earth and the deep ocean floor. Nearly all creationist geologists accept the fundamental principles of this theory. Creationists believe that there are biblical and geological reasons to accept that horizontal plate movements were initiated at the time of the Flood and operated at a rate and intensity far greater than they do today – this is the theory of CPT. The morphology of the Earth and the position of its continents were dramatically changed during and after this dynamic tectonic event. As a result of these high-speed horizontal plate movements, the Earth's crust thickened in areas where deposition, subduction, compression, and collision had occurred. These crustal thickening processes also formed the characteristic deformational structures found in today's mountain belts, such as overthrust belts (Clarey 2013). CPT eventually slowed down when runaway subduction ceased because the original dense oceanic lithosphere was completely consumed. Since then, the Earth has been making its way back to a balanced state. Part of this recovery process involved the rapid isostatic uplift of areas of thickened crust at the end of the Flood year.

> These grandiose structures … cannot be attributed to slow and steady tectonic processes.

Evidence of superquakes, landslides and gravity-driven overthrusts testify to a time in history where tectonic activity was on another level of magnitude and intensity. These grandiose structures, that have been elevated to the highest points on today's Earth, cannot be attributed to slow and steady tectonic processes. However, the creationist theory of CPT better explains the geological conundrum of the origin and elevation of today's mountains and mountain ranges.

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