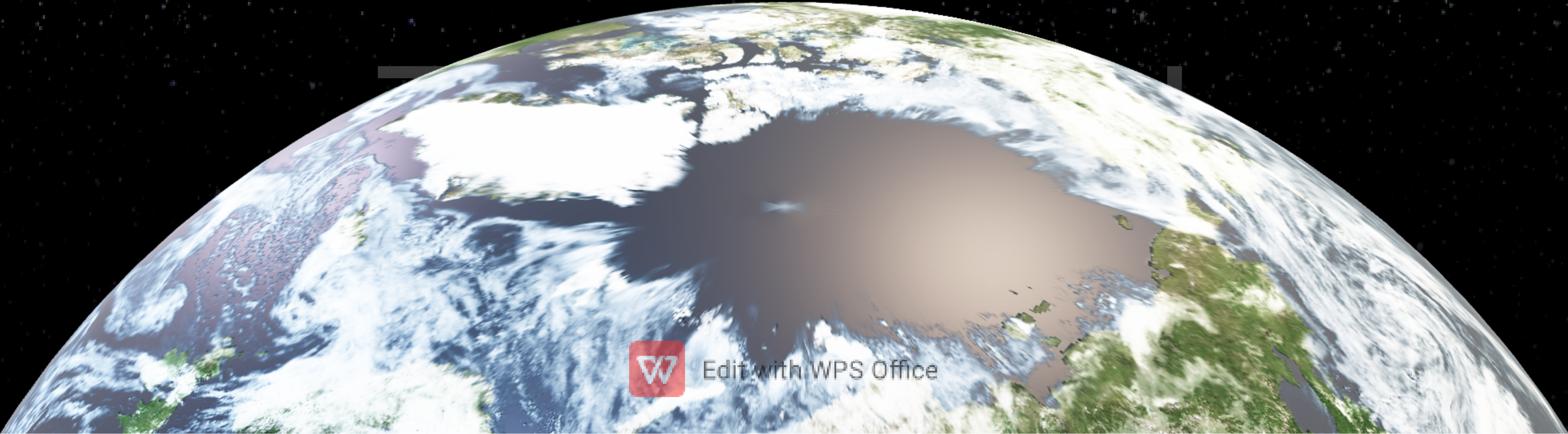
EARTH STRUCTURE AND

INTRODUCTION TO EARTH

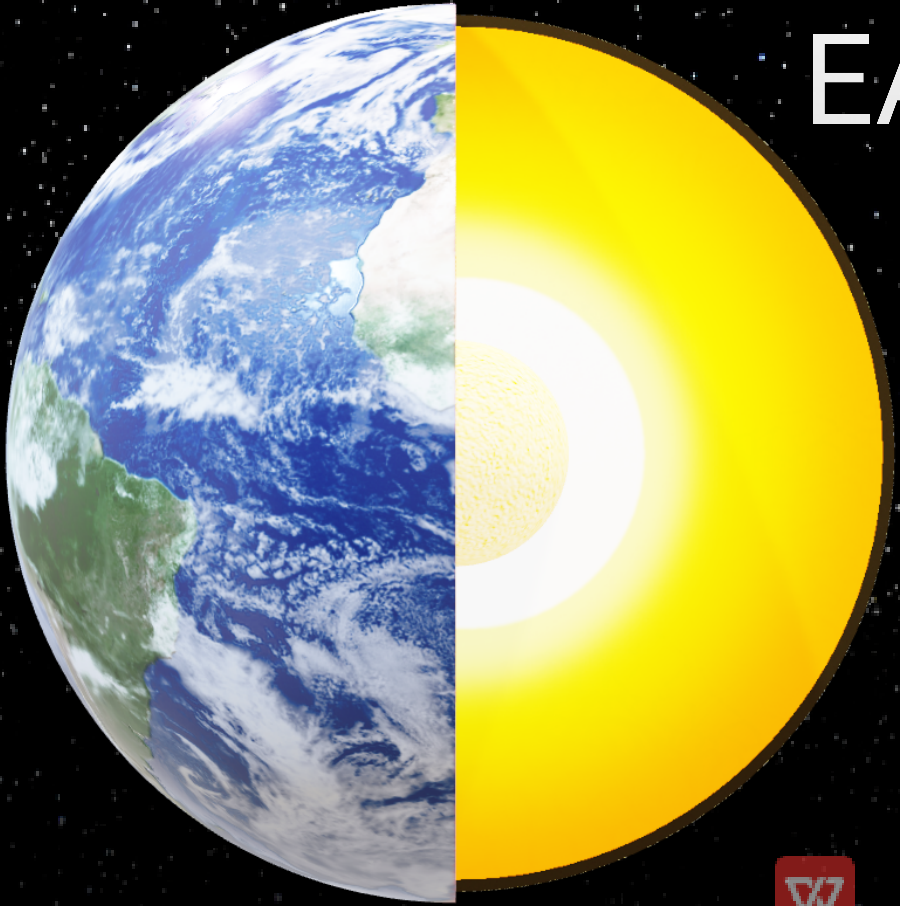
When the solar system settled into its current layout about 4.5 billion years ago, Earth formed when gravity pulled swirling gas and dust together to become the third planet from the Sun. Like its fellow terrestrial planets,

INTERNAL STRUCTURE OF

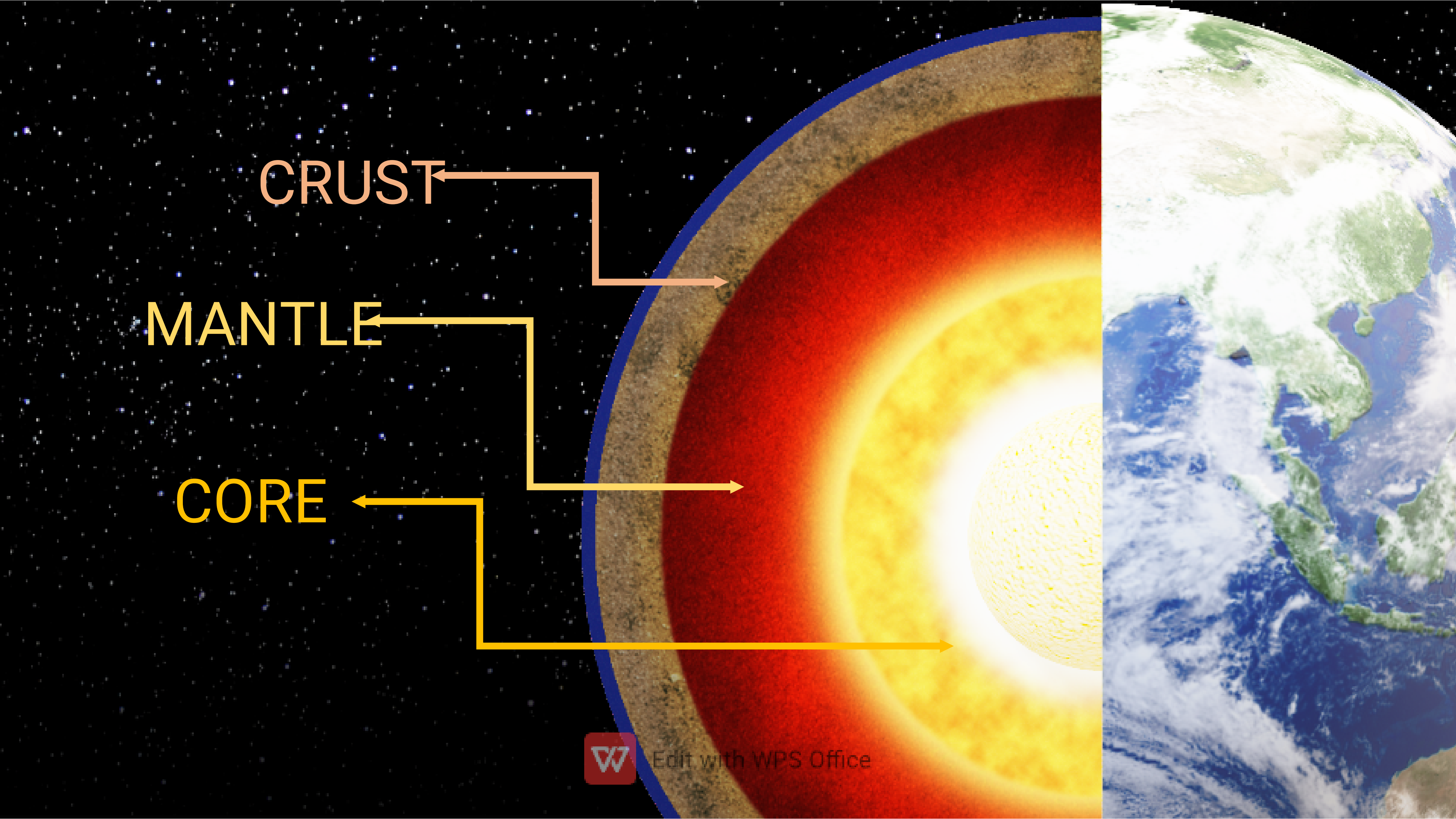


INTERNAL STRUCTURE OF

INTERNAL STRUCTURE OF THE EARTH

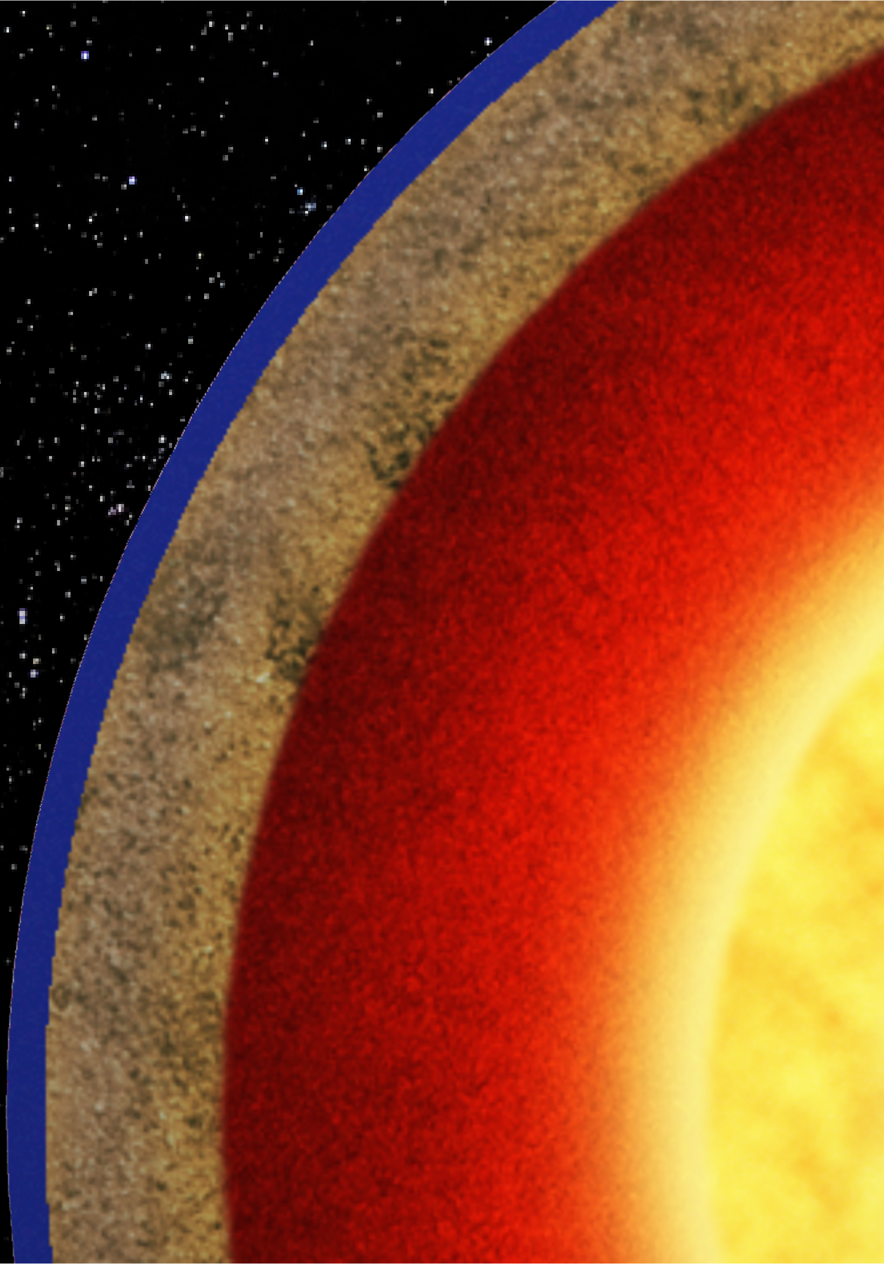


Our planet may look peaceful from space, but beneath its surface lies a restless interior filled with heat, motion, and complexity. The structure of the Earth reveals how our planet was built, how it has evolved, and why it remains geologically active. From the thin crust we live on to the molten outer core that generates Earth's magnetic field, each layer plays a vital role in shaping the planet we call home


CRUST
MANTLE
CORE

CRUST

The crust is the outermost and thinnest layer of Earth. It forms the solid surface where we live and where most geological processes — like earthquakes, mountain building, and erosion — occur

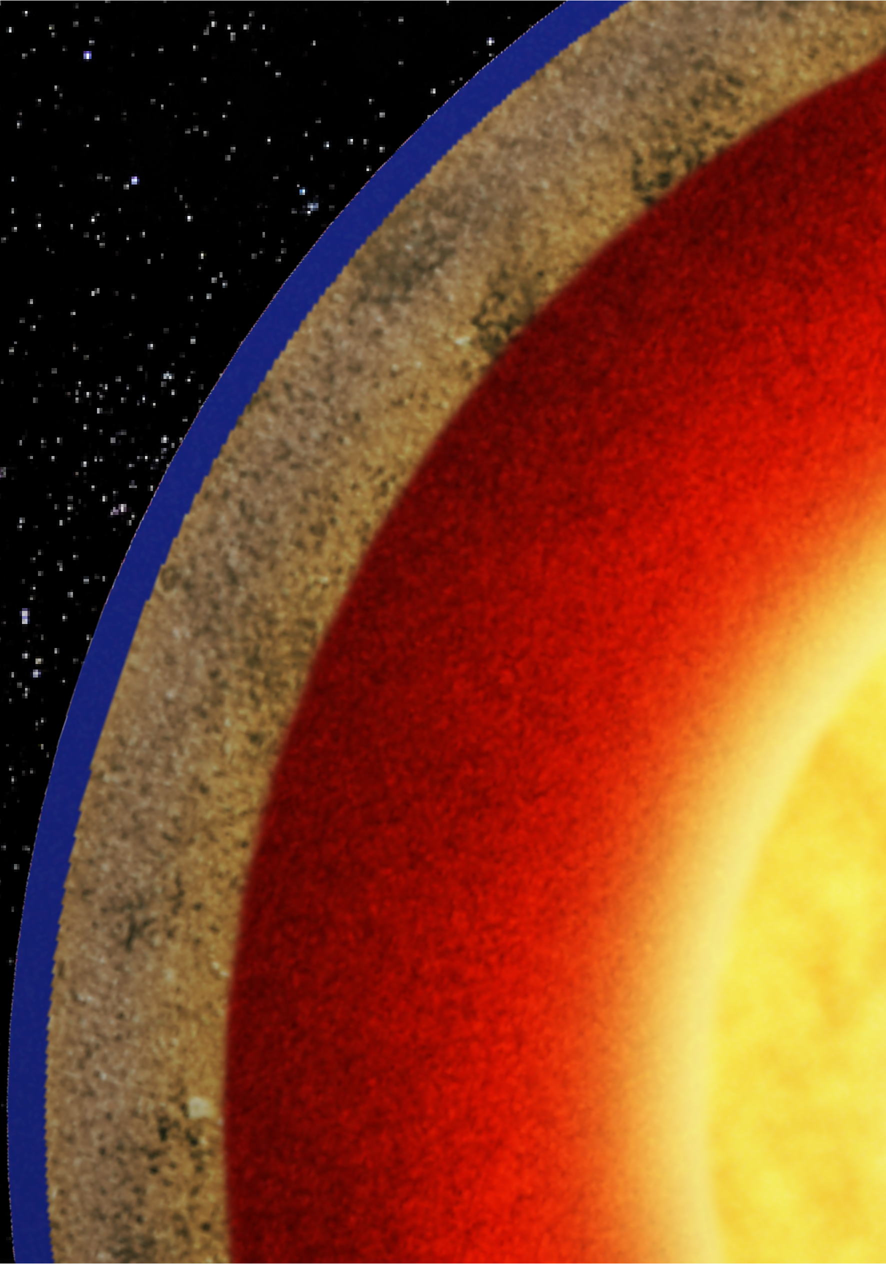


CONTINENTAL CRUST

The crust has a thickness of 30–70 km, is composed mainly of granite and silica-rich rocks, has an average density of 2.7 g/cm^3, and can be up to 4 billion years old.

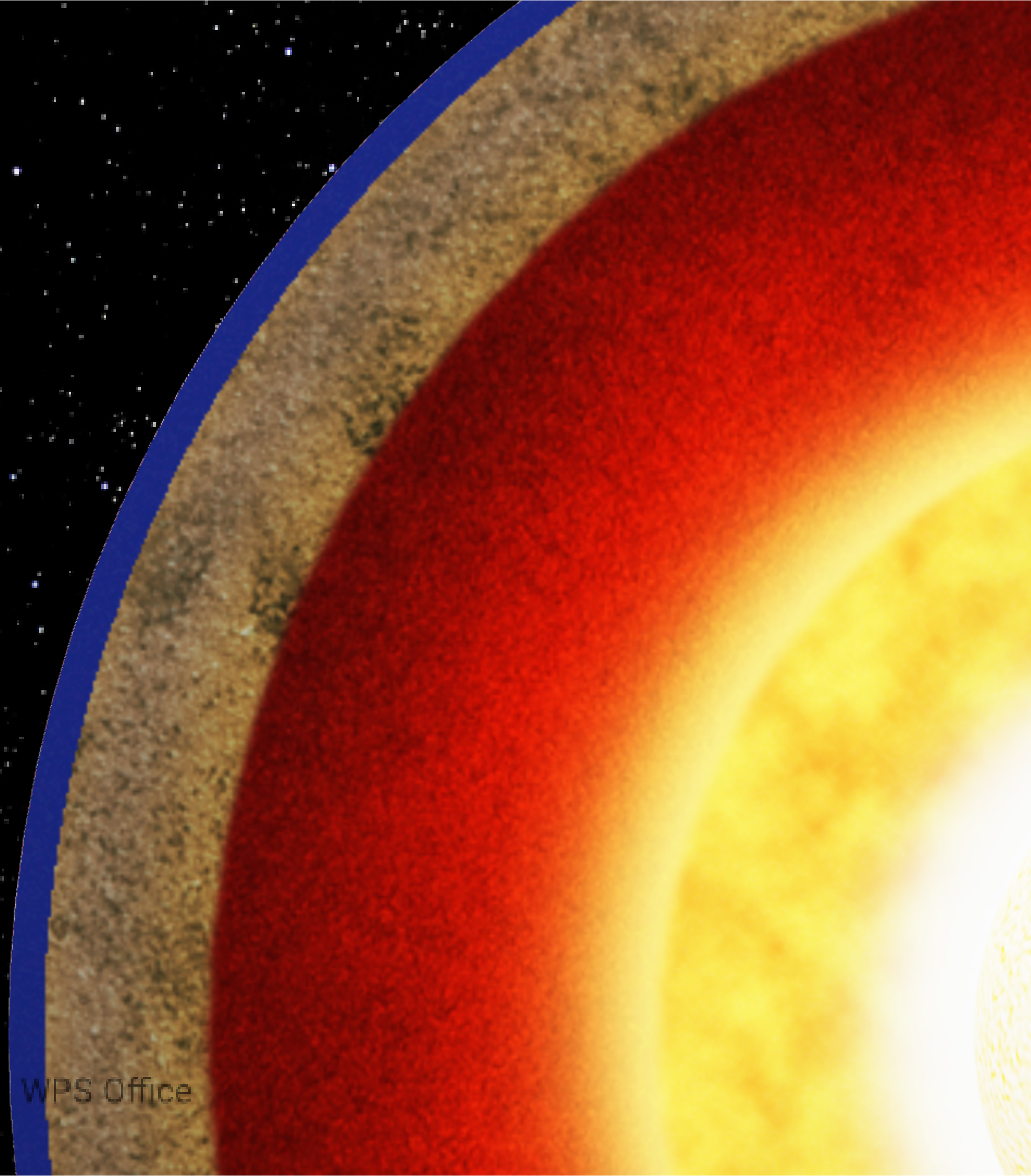
OCEANIC CRUST

The oceanic crust is 5 to 10 kilometers thick, primarily made of basalt and gabbro, and has a density of about 3.0 grams per cubic centimeter. Its age rarely exceeds 200 million years due to seafloor recycling.



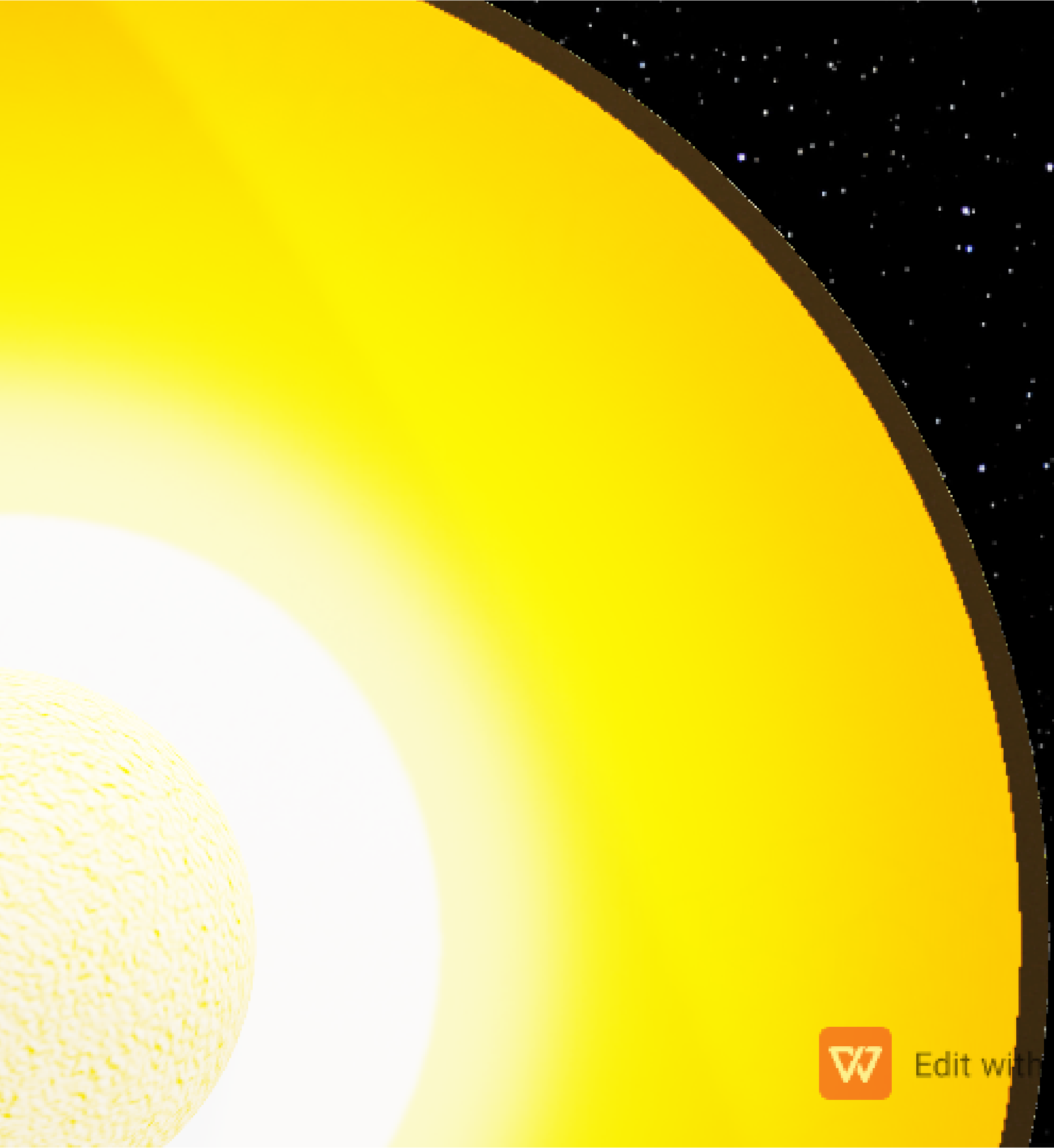
CRUST

The crust and the uppermost mantle together form the lithosphere, a rigid shell broken into tectonic plates that float on the softer asthenosphere beneath.



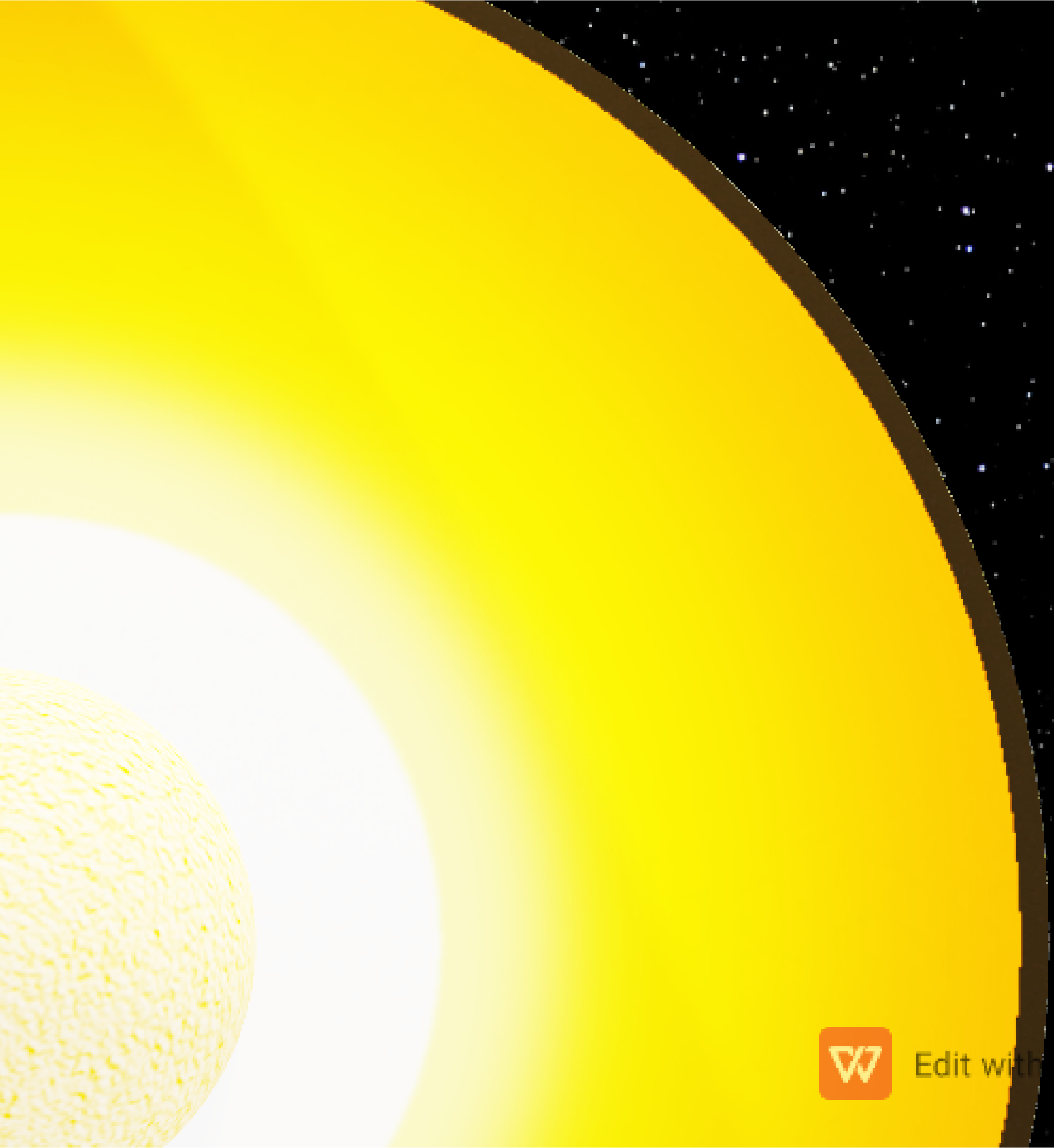
THE MANTLE

Beneath the crust lies the mantle, which makes up about 84% of Earth's volume and extends to a depth of 2,900 kilometers. It is composed mainly of silicate minerals rich in magnesium and iron (like olivine and pyroxene)



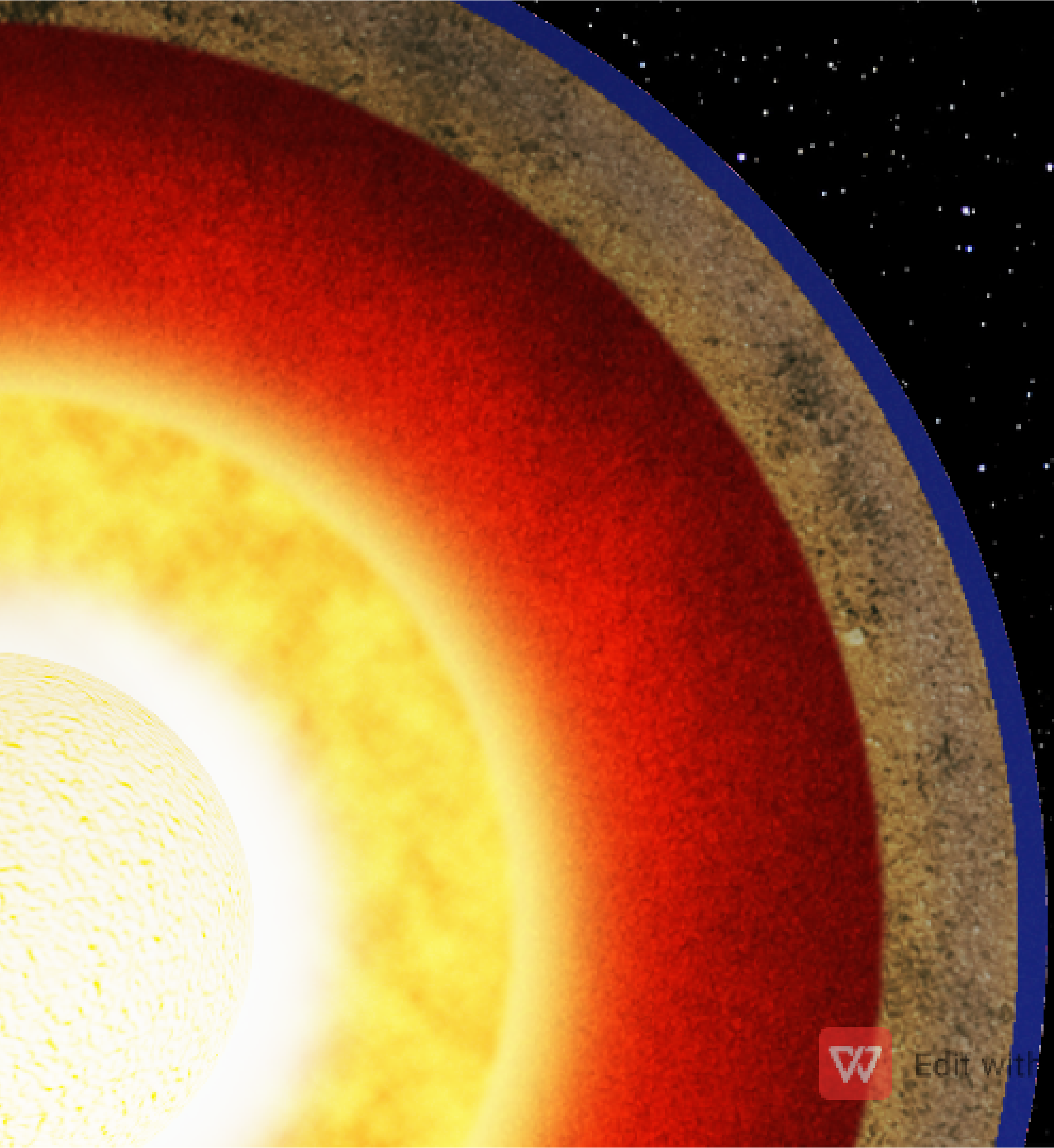
UPPER MANTLE

is closer to the crust, cooler, less dense, and includes the rigid lithosphere (with crust) and the flowing asthenosphere that drives plate tectonics,



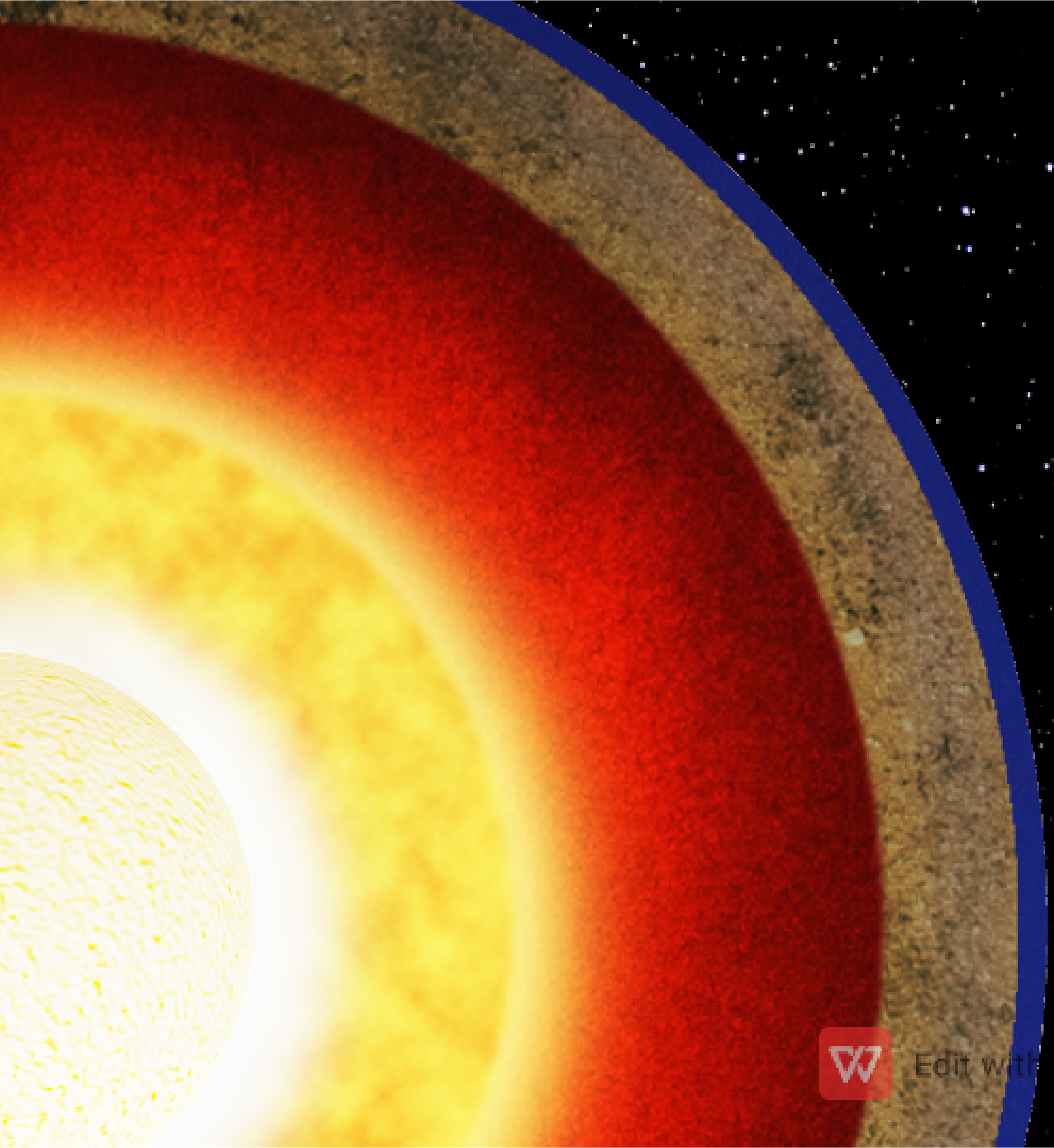
LOWER MANTL

while the lower mantle is much deeper, hotter, under immense pressure, making its rocks solid despite the heat, and composed of denser minerals like bridgmanite.



THE CORE

At the center lies the core, a metallic sphere primarily made of iron (Fe) and nickel (Ni). It accounts for about 15% of Earth's volume but one-third of its mass due to high density.

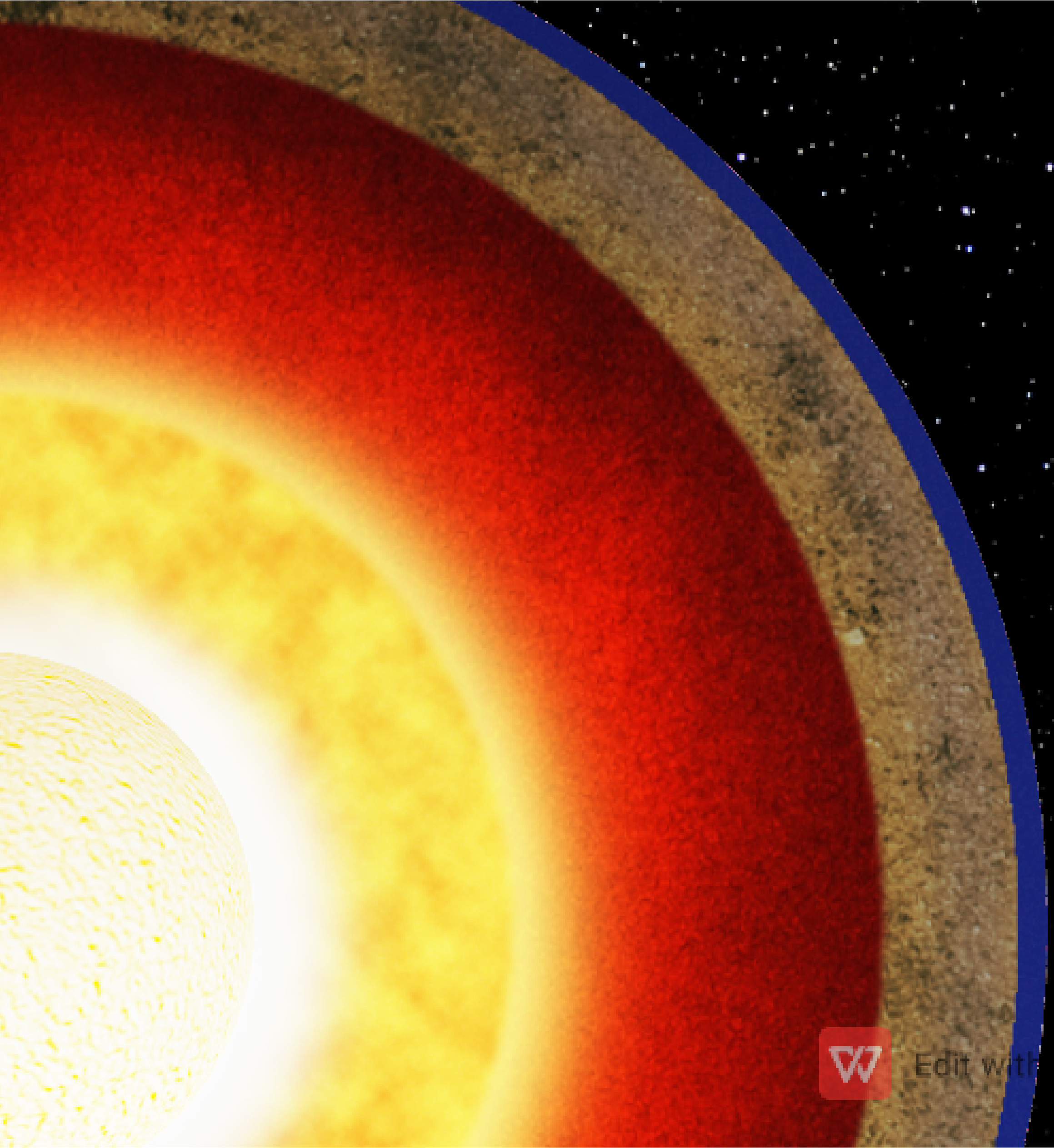


OUTER CORE

Depth: 2,900–5,100 km

Composition: Liquid iron and nickel with lighter elements like sulfur and oxygen.

Temperature: 4,000–5,500°C
This molten metal moves in swirling currents, creating the geomagnetic field through the dynamo effect.



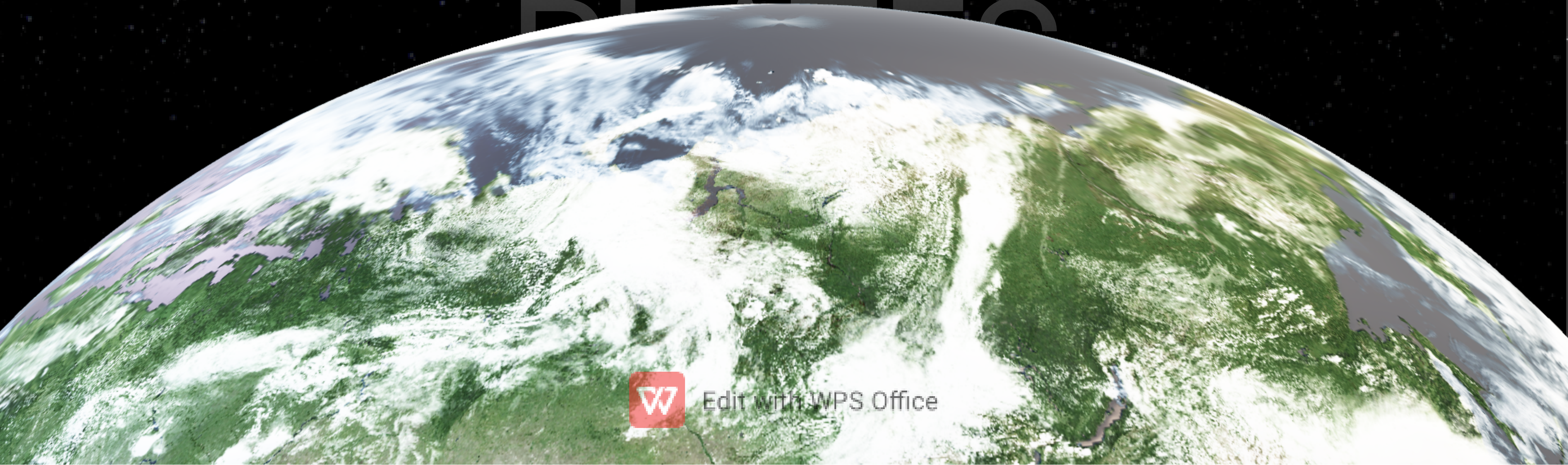
INNER CORE

Depth: 5,100–6,371 km (to the planet's center)

Composition: Solid iron-nickel alloy

Temperature: Up to 6,000°C — as hot as the Sun's surface
Despite high temperature, enormous pressure keeps it solid.

TECTONIC



TECTONIC PLATES

- Plate tectonics is a scientific theory that explains how major landforms are created as a result of Earth's subterranean movements.
- The theory, which solidified in the 1960s, transformed the earth sciences by explaining many phenomena, including mountain-building events, volcanoes, and earthquakes.

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TECTONIC PLATES

- Earth’s lithosphere is broken into large plates that move slowly over the partially molten asthenosphere. Driven by convection, these plates shift a few centimeters per year, and their interactions create major geological features like mountains, rifts, and faults.

TECTONIC PLATES

- Alfred Wegener proposed the theory of continental drift in 1912, suggesting that all continents were once part of a single supercontinent called Pangaea that began breaking apart about 200 million years ago. He supported this idea with matching rocks, similar fossils, and the puzzle-like fit of continents such as South America and Africa.

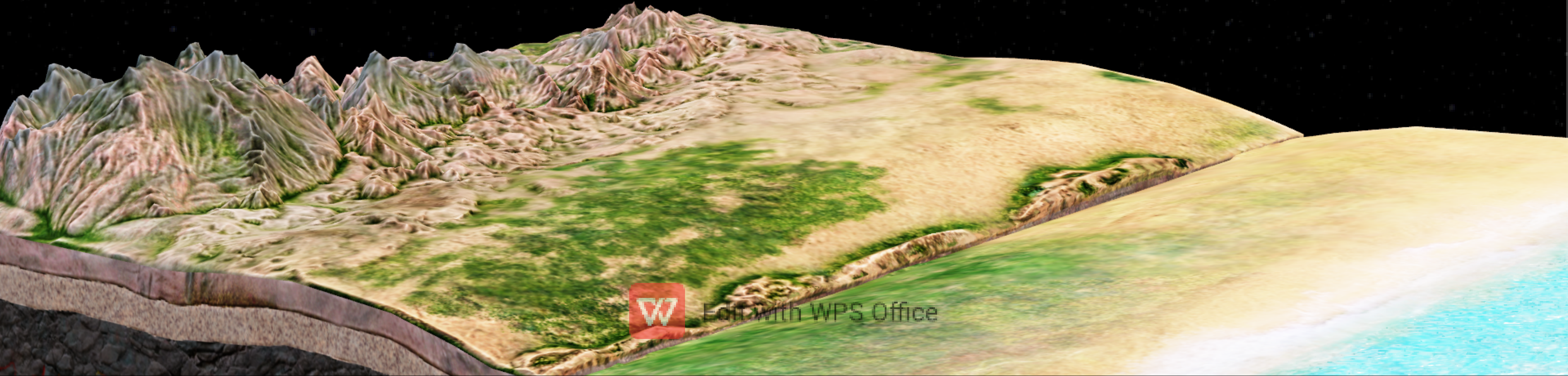
TECTONIC PLATES

- Plate tectonics is the fundamental theory that explains the large-scale motion of Earth's rigid outer shell and the continuous reshaping of the planet's surface (Conrad, 2021; Zheng, 2018).

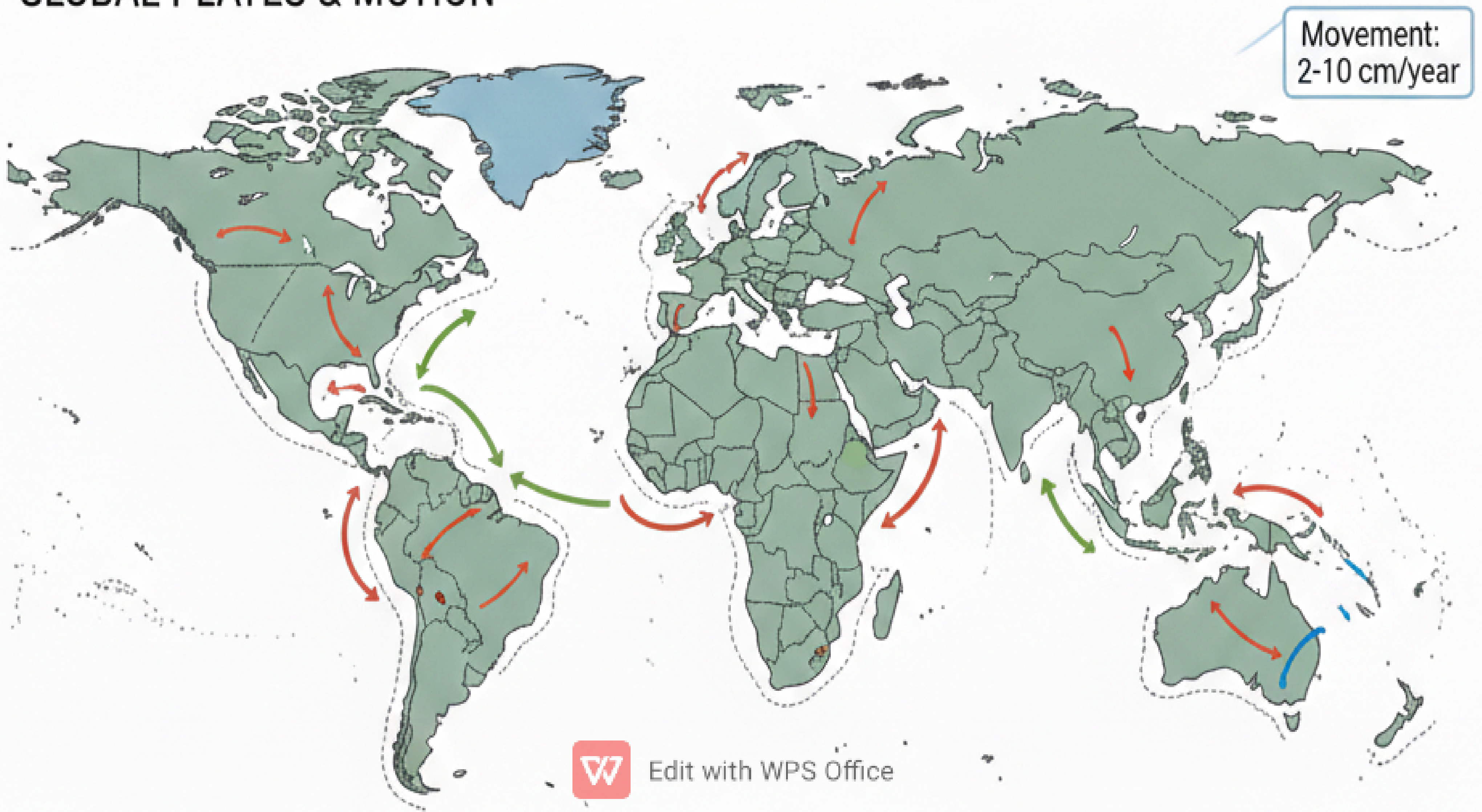
- Earth's outer layer is divided into several rigid lithospheric plates that move

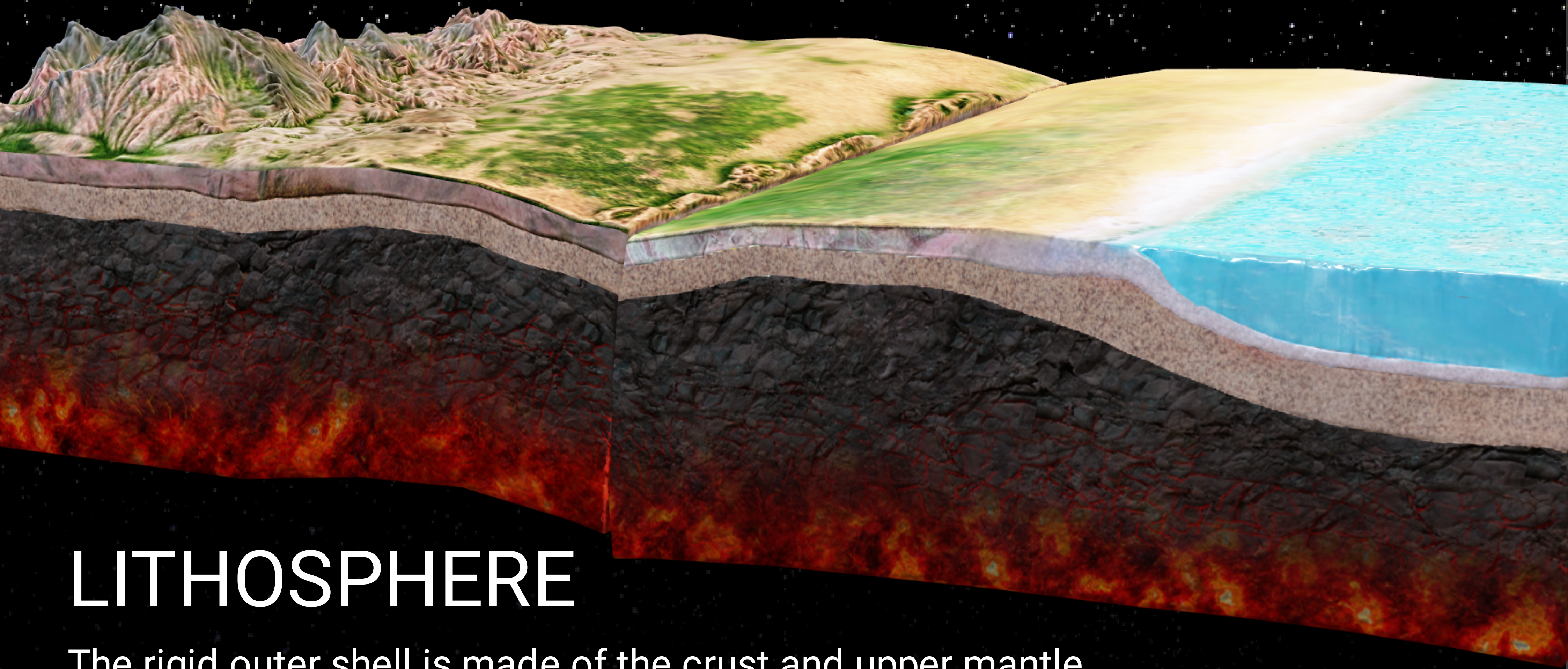
TECTONIC PLATES

The motion of tectonic plates is enabled by the contrast between Earth’s rigid outer layer and the weaker mantle layer beneath it (Cathles et al., 2023).



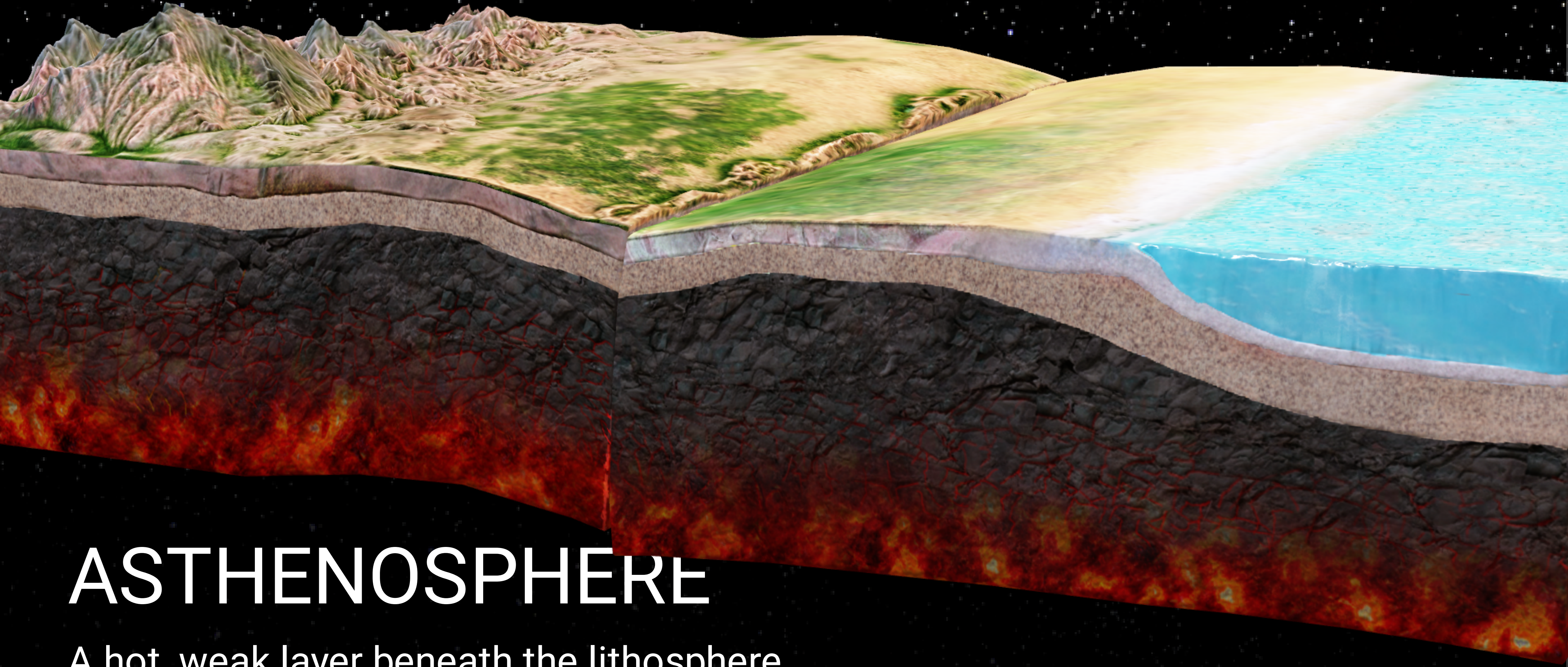
GLOBAL PLATES & MOTION





LITHOSPHERE

The rigid outer shell is made of the crust and upper mantle.
Exists as continental (thicker, less dense) and oceanic (thinner, denser) plates.

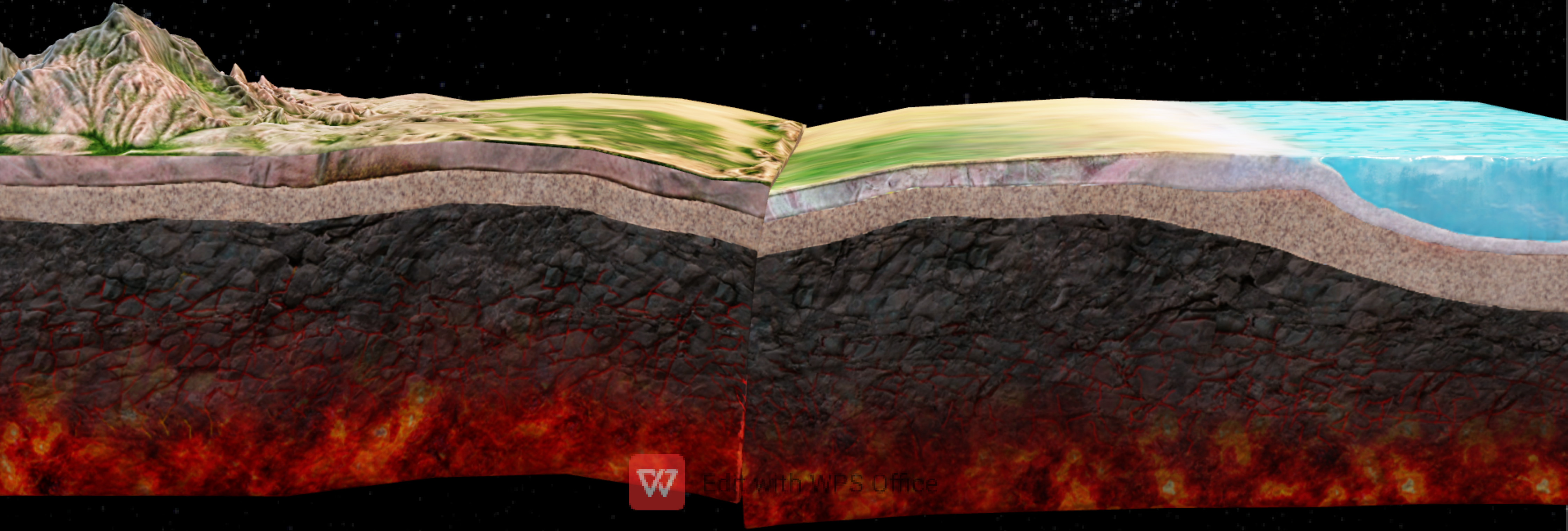


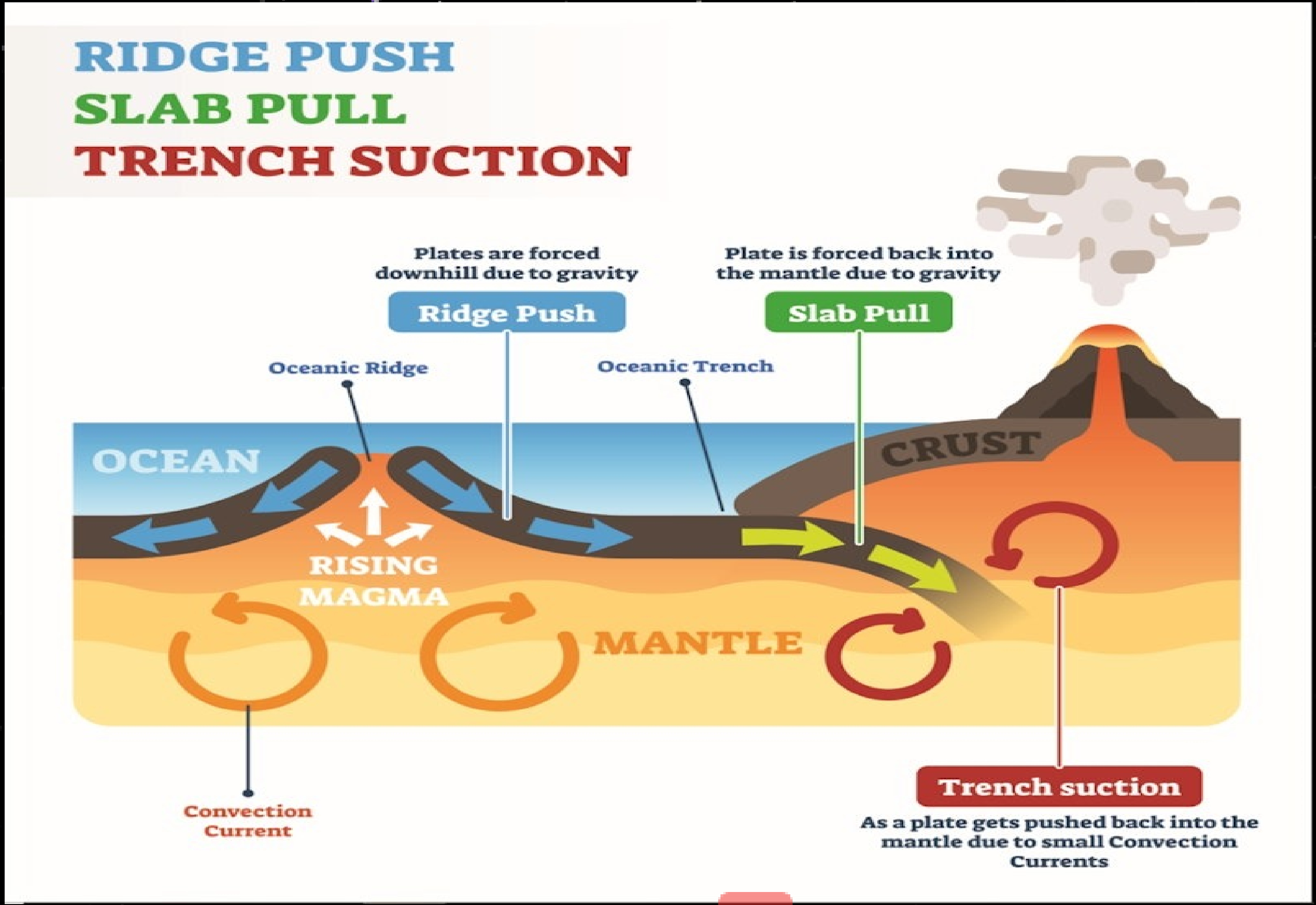
ASTHENOSPHERE

A hot, weak layer beneath the lithosphere.
Though solid, it behaves plastically, allowing plates to glide over it.

This layered structure enables long-term plate movement without breaking Earth's surface apart.

Plate motion is driven by Earth's internal heat and gravity-related forces acting on the lithosphere (Bercovici et al., 2000; Conrad, 2021).

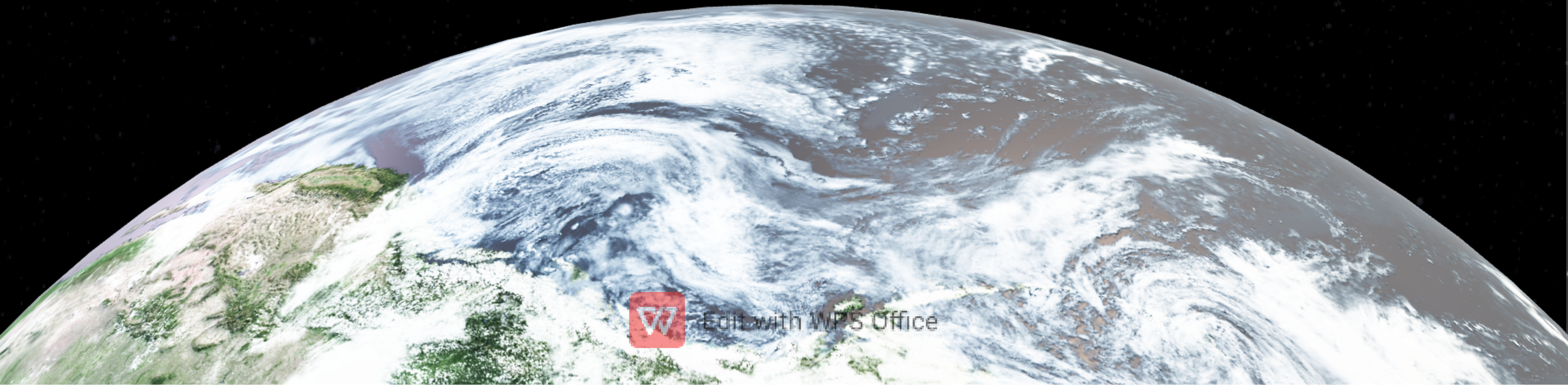




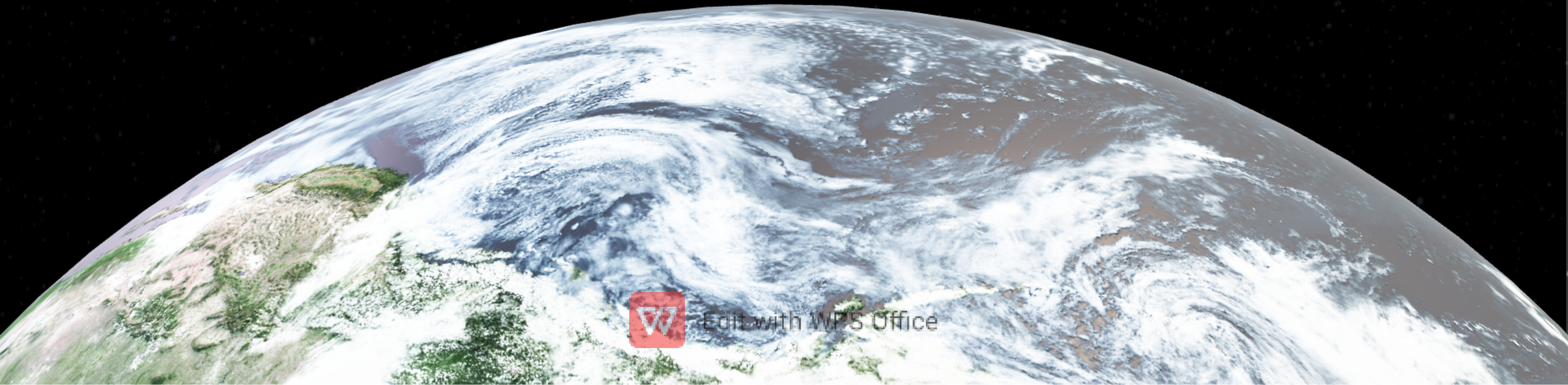
M A N T L E CONVECTION

Heat from Earth’s interior causes hot mantle material to rise and cooler material to sink, helping

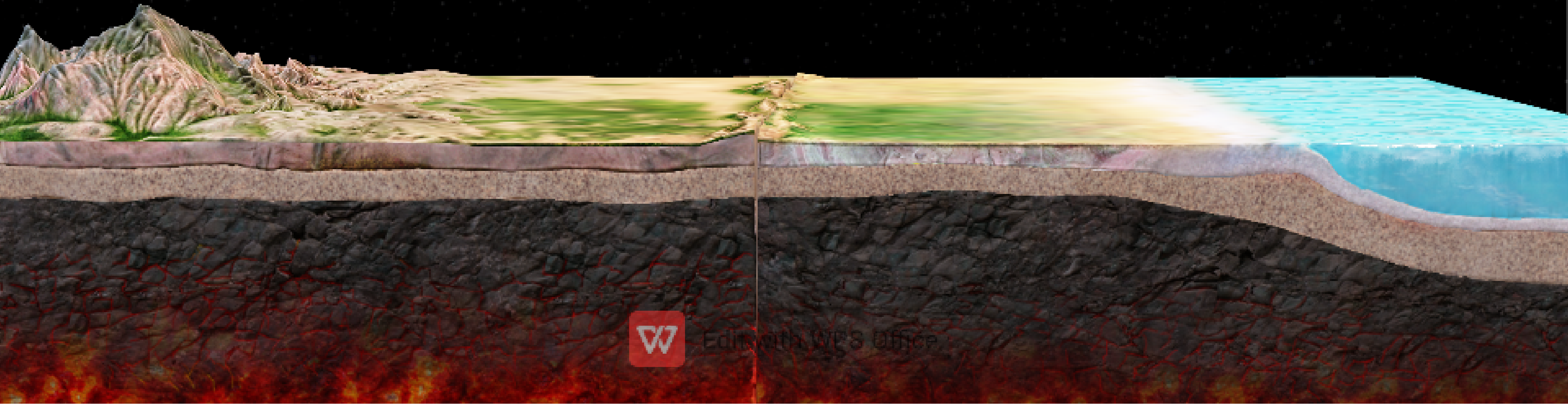
TYPE OF PLATE BOUNDARIES



TYPE OF PLATE BOUNDARIES

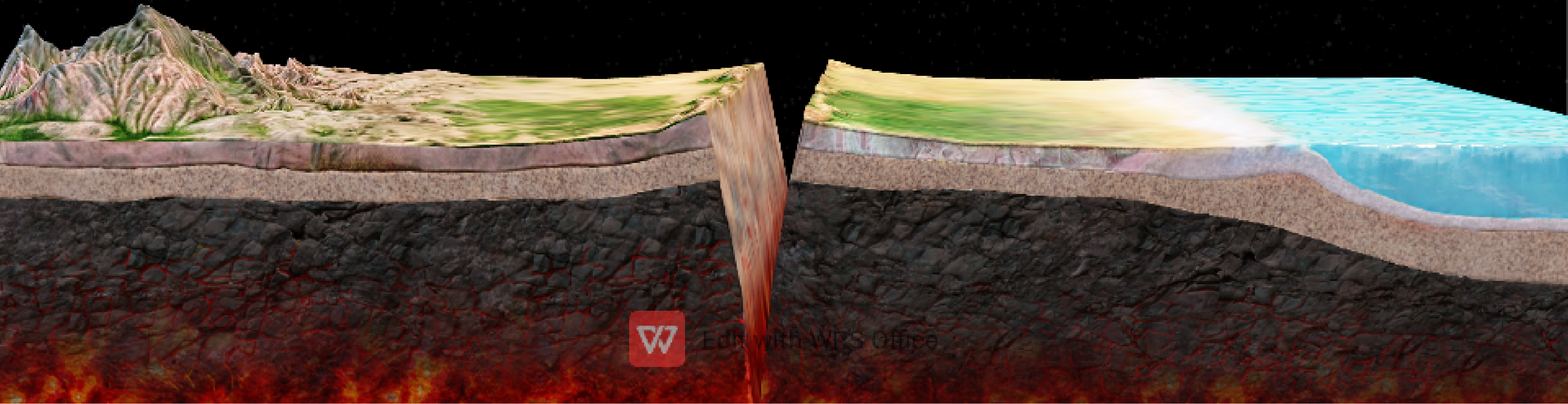


DIVERGENT BOUNDARIES

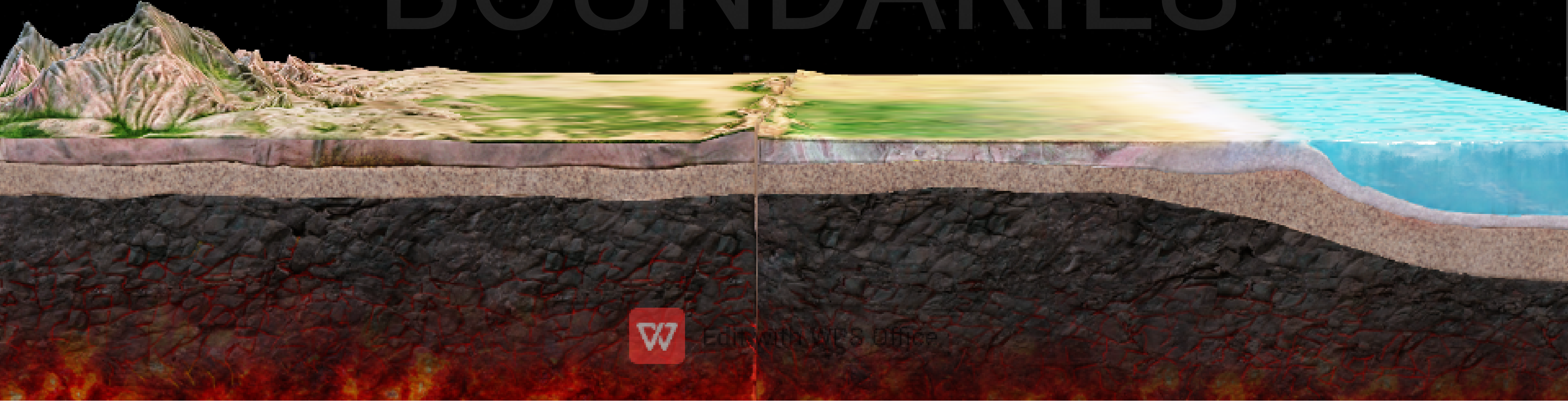


DIVERGENT BOUNDARIES

Occurs when two tectonic plates move away from each other. Along these boundaries, earthquakes are common and magma (molten rock)rises from the Earth's mantle to the surface, solidifying to create new oceanic crust.



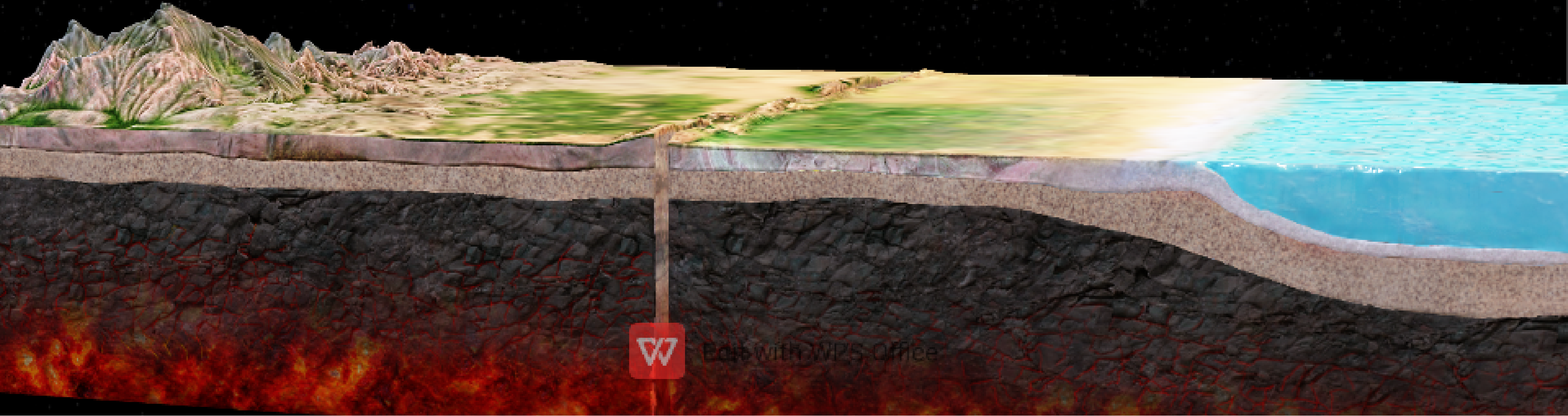
CONVERGENT BOUNDARIES



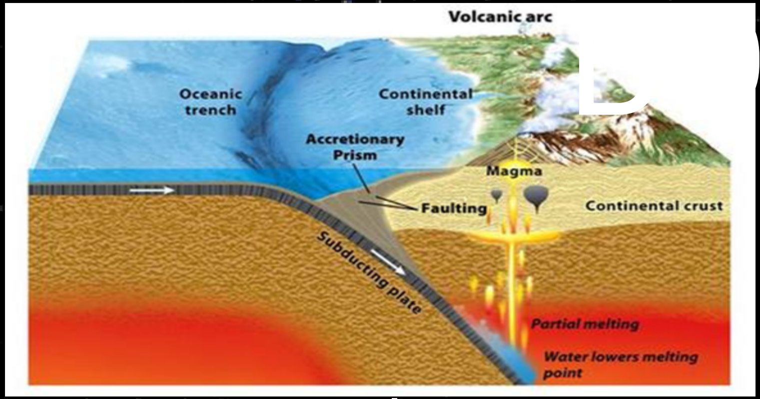
BOUNDARIES

CONVERGENT BOUNDARIES

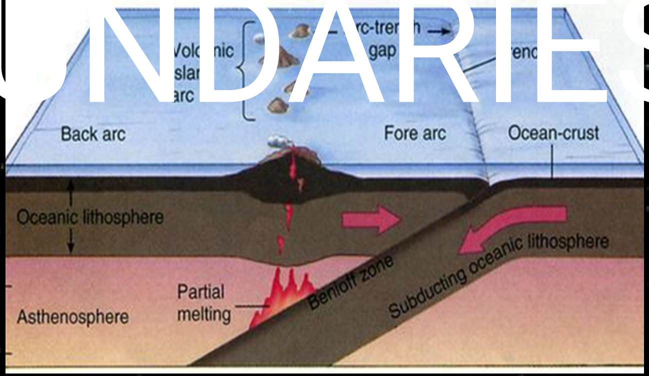
The impact of the colliding plates can cause the edges of one or both plates to buckle up into mountain ranges or one of the plates may bend down into a deep seafloor trench.



TYPES OF CONVERGENT BOUNDARIES



Continental- Oceanic
“Subduction”



Oceanic- Oceanic
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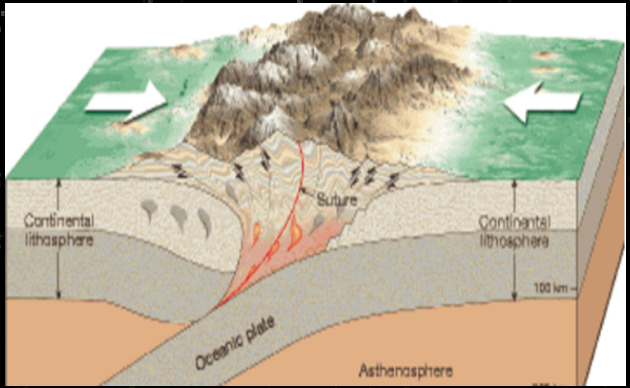
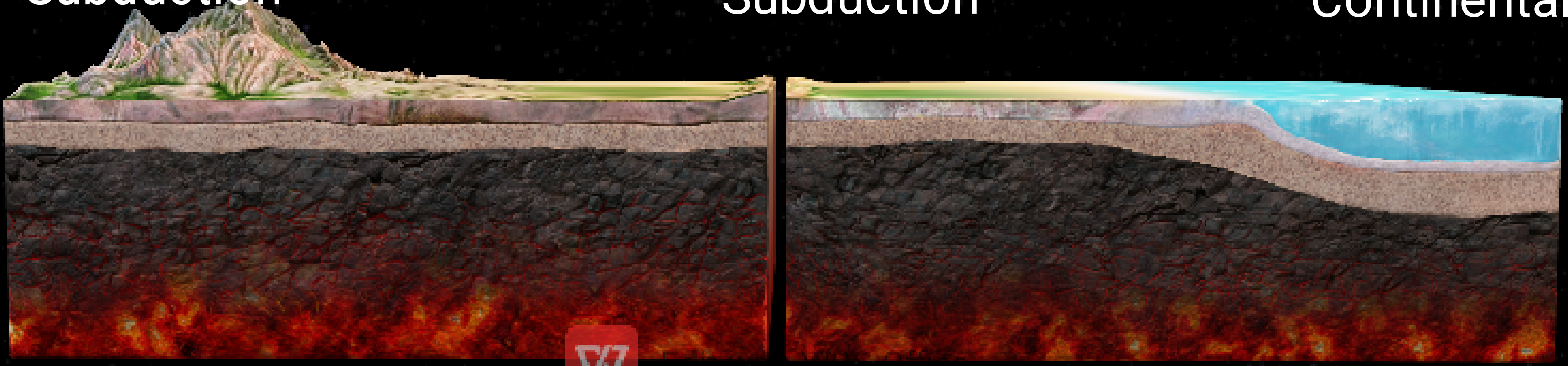
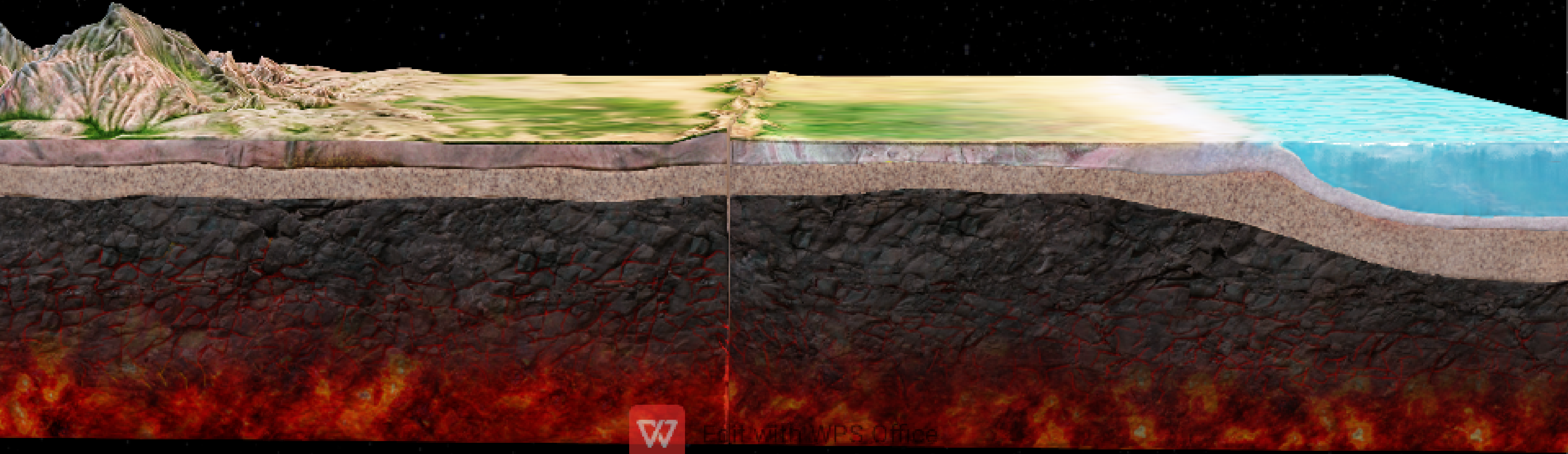


Continental-
Continental

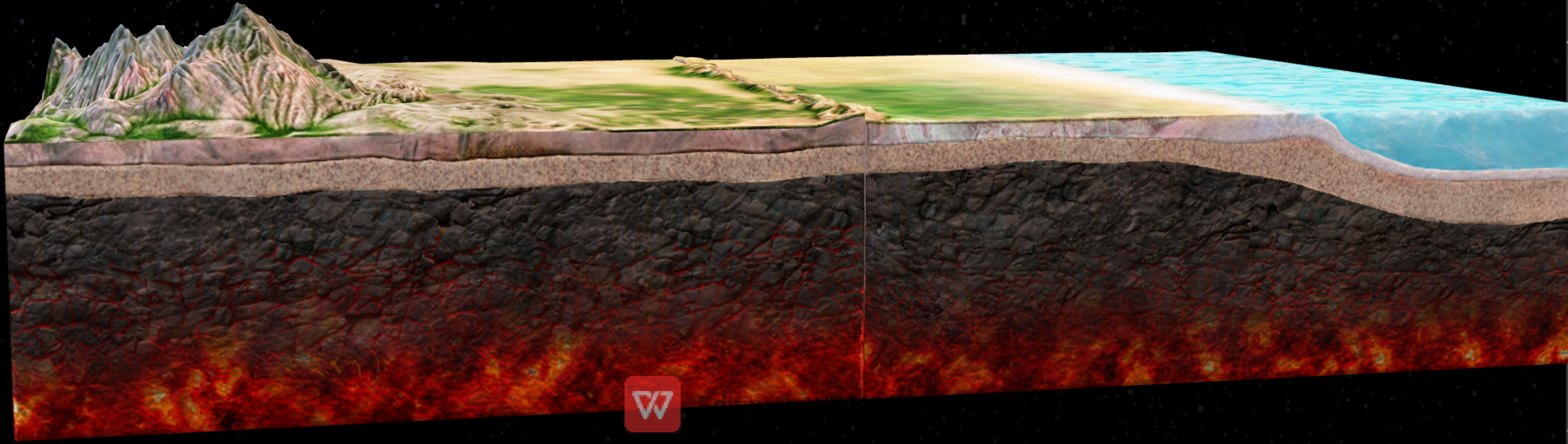


TRANSFORM BOUNDARIES



TRANSFORM BOUNDARIES

Formed where two tectonic plates pass laterally by one another. These boundaries are commonly defined by a series of faults, each of which accommodates some of the translational movement between passing plates.



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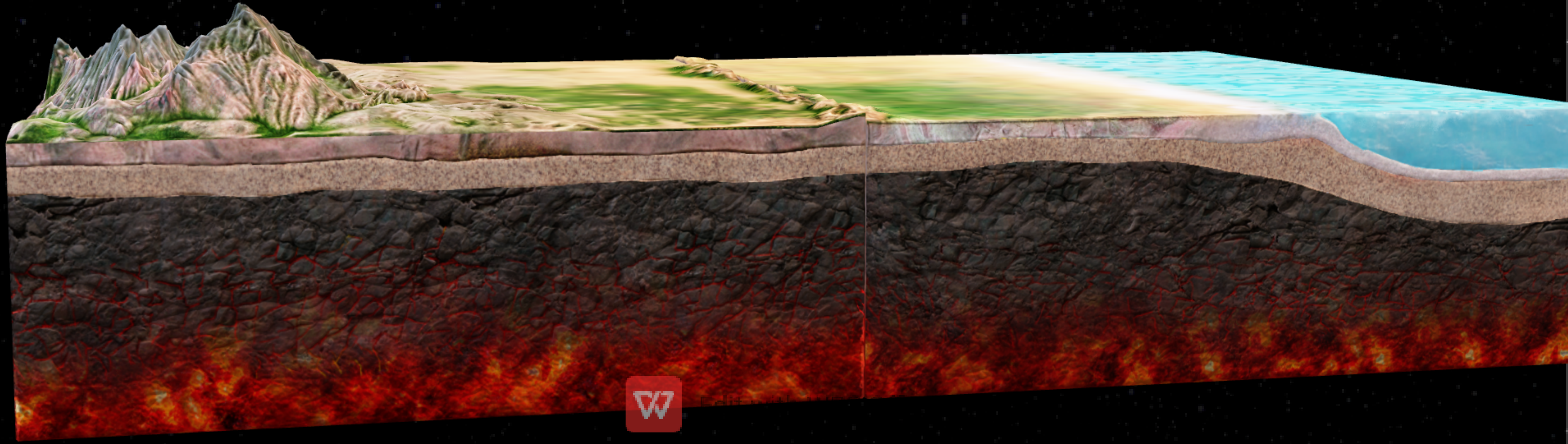
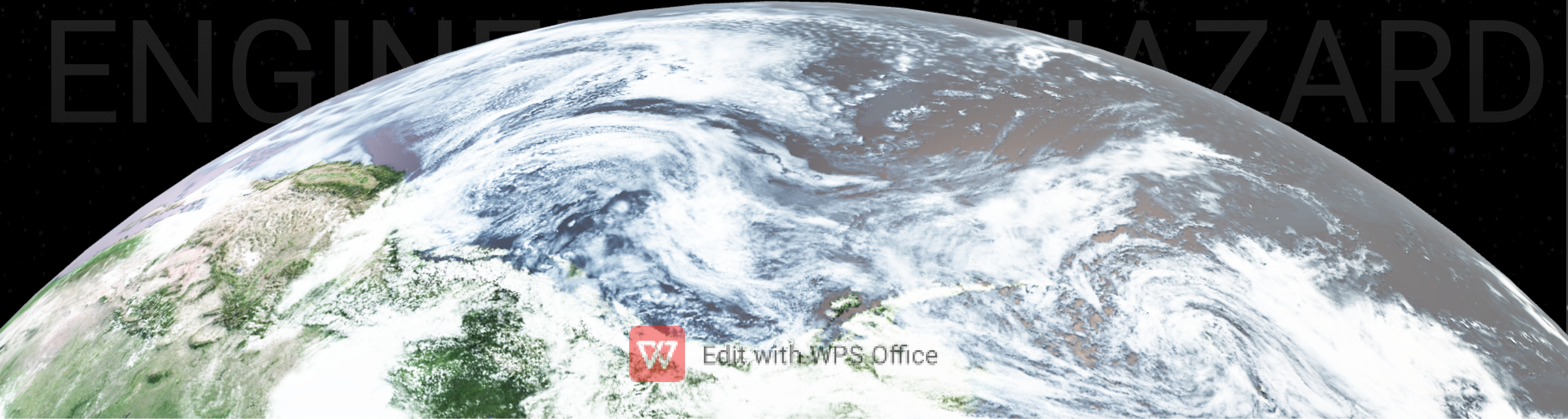


RELATIONSHIP OF TECTONICS TO ENGIN[illegible] HAZARD



EARTHQUAKES

A.) GROUND SHAKING
Damages or destroys structures by creating vibrations.
Causes buildings, bridges, and roads to collapse or crack.

EARTHQUAKES

B.) SURFACE RUPTURE
Fractures the ground directly beneath foundations. Buildings, bridges, and roads built across a fault can be torn apart or severely tilted. Damages foundations, pipelines, roads, and railways built across faults.

VOLCANIC ERUPTIONS

Destroy infrastructure and disrupt transportation. Cause the destruction of acres of land.

TSUNAMI

- is acatastrophic ocean wave, usually caused by a submarine earthquake, an underwater or coastal landslide, or a volcanic eruption.

LIQUEFACTION

Earthquake shaking causes saturated soil to lose strength, causing foundations to fail. Leads to tilting or sinking of buildings and failure of foundations.

LANDSLIDES

Tectonic activity causes steep slopes to fail, affecting dams, roads, and residential areas.
Bury houses, roads, and utilities, cutting off access and services.