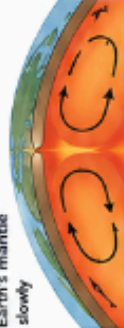
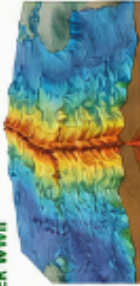


FROM CONTINENTAL DRIFT TO PLATE TECTONICS

How each stage solved a specific objection to Wegener's original idea

STAGE & TIME	KEY DISCOVERY / IDEA	WHAT IT SHOWED	OBJECTION TO WEGENER	HOW THIS STAGE SOLVED IT	REMAINING QUESTION
1 1912 WEGENER'S ORIGINAL IDEA	EVIDENCE FOR CONTINENTAL DRIFT  - Continents fit together like puzzle pieces - Matching fossils across oceans - Matching rock formations and mountain belts - Ancient climate evidence	 The continents were once joined in a supercontinent and later drifted apart.	NO BELIEVABLE MECHANISM "What force could move entire continents across solid ocean crust?" 	✓ Provided strong evidence that continents had moved. <i>BUT: No mechanism to cause the movement.</i>	—
2 1920s–30s EARTH'S INTERIOR	MANTLE CONVECTION Scientists learned Earth's mantle behaves like a very slowly flowing solid. 	Heat from Earth's interior can drive convection—providing a possible source of motion beneath the continents. $q = -k \frac{dT}{dx}$ (Heat flow drives convection.) The ocean floor is not flat or static—it has mountains, valleys, and trenches. 	CONTINENTS CANNOT MOVE No known force was strong enough to move continents across the ocean floor.	✓ Demonstrated a possible source of motion beneath continents.	Still no direct evidence that continents were actually moving.
3 1940s–50s SEAFLOOR MAPPING	SONAR MAPPING AFTER WWII Sonar revealed: - Mid-ocean ridges - Deep ocean trenches - Extensive undersea mountain systems 	The seafloor is geologically active.	OCEAN FLOOR IS FIXED The ocean floor was thought to be flat, old, and permanent.	✓ Revealed a dynamic, active ocean floor—opening the door to new ideas about Earth's surface.	Still no proof of continental movement.
4 1950s PALEO-MAGNETISM	MAGNETIC RECORDS IN ROCKS Iron minerals in rocks preserve Earth's magnetic field when they form. - Apparent polar wander paths - Symmetrical magnetic <i>isochrons</i> patterns  HARRY HESS' NEW IDEA Magma rises at mid-ocean ridges. New oceanic crust forms and moves outward. 	Continents have changed position through time. The magnetic patterns make sense only if continents moved.	NO EVIDENCE OF MOVEMENT There was no proof that continents had actually moved.	✓ Provided strong evidence that continents have moved over geologic time.	How is new crust created, and how is old crust destroyed?
5 1962 SEAFLOOR SPREADING		The seafloor spreads like a conveyor belt. Continents ride on moving lithospheric plates.	NO MECHANISM FOR DRIFT There was still no process that could move continents.	✓ Provided the missing mechanism for continental movement. ✓ Explained how plates move: new crust forms at ridges and pushes plates apart.	Where does old seafloor go?
6 1965–68 SUBDUCTION & PLATE TECTONICS	SUBDUCTION COMPLETES THE PICTURE Old oceanic crust sinks into the mantle at deep-ocean trenches. 	Earth's outer shell is broken into plates that move, collide, pull apart, and slide past each other.	CRUST WOULD ACCUMULATE FOREVER Without a way to recycle old crust, Earth would run out of space.	✓ Explained crust recycling (subduction). ✓ Explained earthquakes. ✓ Explained volcanoes. ✓ Explained mountain building. ✓ Unified many geologic processes into one comprehensive theory.	— The major objections to Wegener's idea are now answered.

THE BIG PICTURE

Wegener was right about the continents—but wrong about the mechanism.

EACH DISCOVERY ANSWERED A KEY CRITICISM



THE RESULT

From an "interesting idea" in 1912 to the unifying theory of **PLATE TECTONICS** by 1968—one of the greatest scientific advances in Earth science.

