# The Depth of the Ocean Is an Age Before It Is a Landform, and Only the Trenches Lie Outside That Rule

— with depth $= 2500 + 350\sqrt{t}$, even the oldest existing seafloor, $180$ Myr, lies only at $7195.7428$ m, while a trench's $11000$ m would demand $589.7959$ Myr — the separator is the square-root law of cooling against another mechanism, subduction — [Paper 682]

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— *From thinking to syncing.* —

**Abstract**

**The depth of the ocean is taken for a landform. But most of it is fixed by nothing except how long ago that piece of floor was born.What an age explains and what it cannot is marked off here with a single relation.No new theorem or law is claimed. First, and this is the core. Depth follows the square root of age——$3606.7972$ m at 10 Myr, $5630.4952$ m at 80 Myr and $7195.7428$ m at 180 Myr** (Section 2). **Second, being a square root, old floor stops sinking——a fourfold age brings exactly twice the increment, so the older the floor the more slowly it descends** (Section 2). **Third, the mean depth of the ocean belongs to very young floor——3688 m corresponds to $11.5212$ Myr, and most of the seafloor is older than that and deeper** (Section 2). **Fourth, only the trenches lie outside the relation——reaching 11000 m by the square-root law would take $589.7959$ Myr, which is $3.276644$ times the oldest seafloor that exists on Earth** (Section 3). **Fifth, the shortfall is not marginal——even the oldest seafloor is $3804.2572$ m shallower than a trench, leaving more than a third of the depth unexplained** (Section 3). **Sixth, the separator is the square-root law of cooling against another mechanism——nearly all of the ocean's depth is what cooling and contraction leave behind, while a trench records being pushed down** (Section 4). **Keywords**: age of the seafloor, square-root law, conductive cooling, ocean trench, subduction, lithospheric thickness.

**Scope of this paper (scope note)**: **No new theorem or law is claimed——that the depth of the seafloor grows as the square root of its age, the coefficients of that relation, and the diffusion length of heat are all standard (Parsons and Sclater 1977, Turcotte and Schubert 2014).The mechanics of subduction is not treated——slab pull, the cross-section of a trench and the structure of a forearc are left out. It is only said that another mechanism is required.The coefficients are not claimed——2500 m and 350 are representative and move between ocean basins. Beyond about 80 Myr a flattening is sometimes used; here the plain square-root law is carried to the end.Ridges are not treated——ridge topography, hydrothermal activity and the making of crust are not the subject.No particular sounding is claimed——the 11000 m of a trench is a representative value and the precision of measurement is not discussed.Relation to earlier papers**: **Paper 669 showed that rock convects not because it is soft but because it is large, putting the same thermal diffusivity into a critical Rayleigh number——there heat was carried by flow; here the same diffusivity enters the thickness of a plate cooling by conduction from its surface, and through it the depth.**What is added is **tabulating depth against age**, **inverting the relation to the 589.7959 Myr a trench would require**, **showing that to be 3.276644 times the oldest seafloor that exists**, **putting the shortfall at 3804.2572 m**, and **placing the separator on cooling against another mechanism**.

## 1. Notation and the Question

**Setting**: **oceanic crust is born at a ridge and cools and contracts as it moves away. Its depth grows as the square root of the time since it was born.**

$$d(t) = 2500 + 350\sqrt{t}\ \ [\mathrm{m}], \qquad \delta(t) = \sqrt{\kappa t}, \qquad \kappa = 10^{-6}\ \mathrm{m^2/s}$$

**Here $t$ is in millions of years. The quantity $\delta$ is the distance heat has diffused, a measure of the thickness of the cooled and stiffened plate.**

**Question**: **how much of the ocean's depth is explained by age alone?**

## 2. Depth Is Age

**Computation 2.1**: **the depth and the diffusion length were derived for each age.**

| age | depth | diffusion length of heat |
|---|---|---|
| 1 Myr | 2850.0000 m | — |
| 10 Myr | 3606.7972 m | 17.7645 km |
| 20 Myr | 4065.2476 m | — |
| 50 Myr | 4974.8737 m | — |
| 80 Myr | 5630.4952 m | 50.2455 km |
| 120 Myr | 6334.0579 m | — |
| 180 Myr | 7195.7428 m | 75.3682 km |

> **Observation 2.2**
>
> this is the core: a chart of the seafloor is a map of ages as much as of landforms.Read one depth and an age is fixed; read one age and a depth is fixed——over nearly all of the seafloor nothing beyond this one relation is needed.

> **Observation 2.3**
>
> being a square root, older floor sinks ever more slowly.A fourfold age yields only twice the increment——sinking comes from cooling, and a plate already cooled has little cooling left to do.

**Computation 2.4**: the mean depth of the ocean, 3688 m, corresponds to an age of 11.5212 Myr.

> **Observation 2.5**
>
> the mean lies towards the young side.Most of the seafloor is older than 11.5212 Myr and therefore deeper than the mean——“mean depth” is not a representative value but a marker on one flank of a distribution.

## 3. A Trench Is the Unexplained Remainder

**Computation 3.1**: to give the 11000 m of a trench, the square-root law requires an age of 589.7959 Myr.

**Observation 3.2**

**no such seafloor exists on Earth.The oldest is about 180 Myr, and the age required is 3.276644 times that ——seafloor is subducted and destroyed long before it could reach such an age.**

**Computation 3.3**: **the oldest seafloor, at 180 Myr and 7195.7428 m, is 3804.2572 m shallower than a trench.**

**Observation 3.4**

**the shortfall is not within any error.More than a third of the depth of a trench is left unaccounted for by cooling——what is missing is not age but mechanism.**

**Observation 3.5**

**the failure of the relation is itself information.A relation that holds over nearly the whole ocean fails badly in one kind of place——the size of that failure marks where another force is at work.**

## 4. The Separator

**Observation 4.1**

**the separator is the square-root law of cooling against another mechanism.What has cooled and contracted has a depth fixed by age alone; what is being pushed down has a depth unrelated to age——the single phrase “deep ocean” counts two quite different histories as one.**

**Observation 4.2**

**beside Paper 669.Paper 669 showed that rock convects not because it is soft but because it is large, using the same thermal diffusivity of $10^{-6}$ $\mathrm{m}^2/\mathrm{s}$——there heat was carried by flow; here the same quantity gives the thickness of a plate losing heat by conduction from its surface. One diffusivity enters a criterion for convection inside and a formula for depth at the surface.**

**Observation 4.3**

**what is not said.Neither the mechanics of subduction nor ridge topography is treated, and the coefficients are representative——what is shown is the range over which one relation holds, and the size of the place where it does not.**

## 5. Roll Call and Closing

1. **3606.7972 m at 10 Myr** (Computation 2.1): **age fixes depth.**
2. **5630.4952 m at 80 Myr** (Computation 2.1): **growth as a square root.**
3. **7195.7428 m at 180 Myr** (Computation 2.1): **the oldest seafloor.**
4. **fourfold age, twice the increment** (Observation 2.3): **old floor stops sinking.**
5. **mean depth is 11.5212 Myr** (Computation 2.4): **a marker, not a centre.**
6. **a trench would need 589.7959 Myr** (Computation 3.1): **no such floor exists.**
7. **that is 3.276644 times** (Observation 3.2): **the core.**
8. **short by 3804.2572 m** (Computation 3.3): **not an error.**
9. **plate thickness 75.3682 km** (Computation 2.1): **at 180 Myr.**
10. **cooling or another mechanism** (Observation 4.1): **the separator; Paper 669.**

**Closing**: **The depth of the ocean is an age before it is a landform.Seafloor of 10 Myr lies at 3606.7972 m, of 80 Myr at 5630.4952 m, and the oldest at 180 Myr at 7195.7428 m; nearly the whole seafloor follows from that one relation.Being a square root, a fourfold age brings only twice the increment.Only the 11000 m of a trench lies outside it——the relation would demand 589.7959 Myr, which is 3.276644 times the oldest seafloor that exists on Earth.Even that oldest floor is 3804.2572 m shallower than a trench, leaving more than a third of the depth unaccounted for——what is missing is not age but mechanism.The separator is the square-root law of cooling against another mechanism, subduction.Placed among the earlier papers——in Paper 669 the same thermal diffusivity entered a criterion for convection inside; here it enters the thickness of a plate cooling at the surface.To be honest——the mechanics of subduction is not treated and every coefficient is representative.**

## References


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