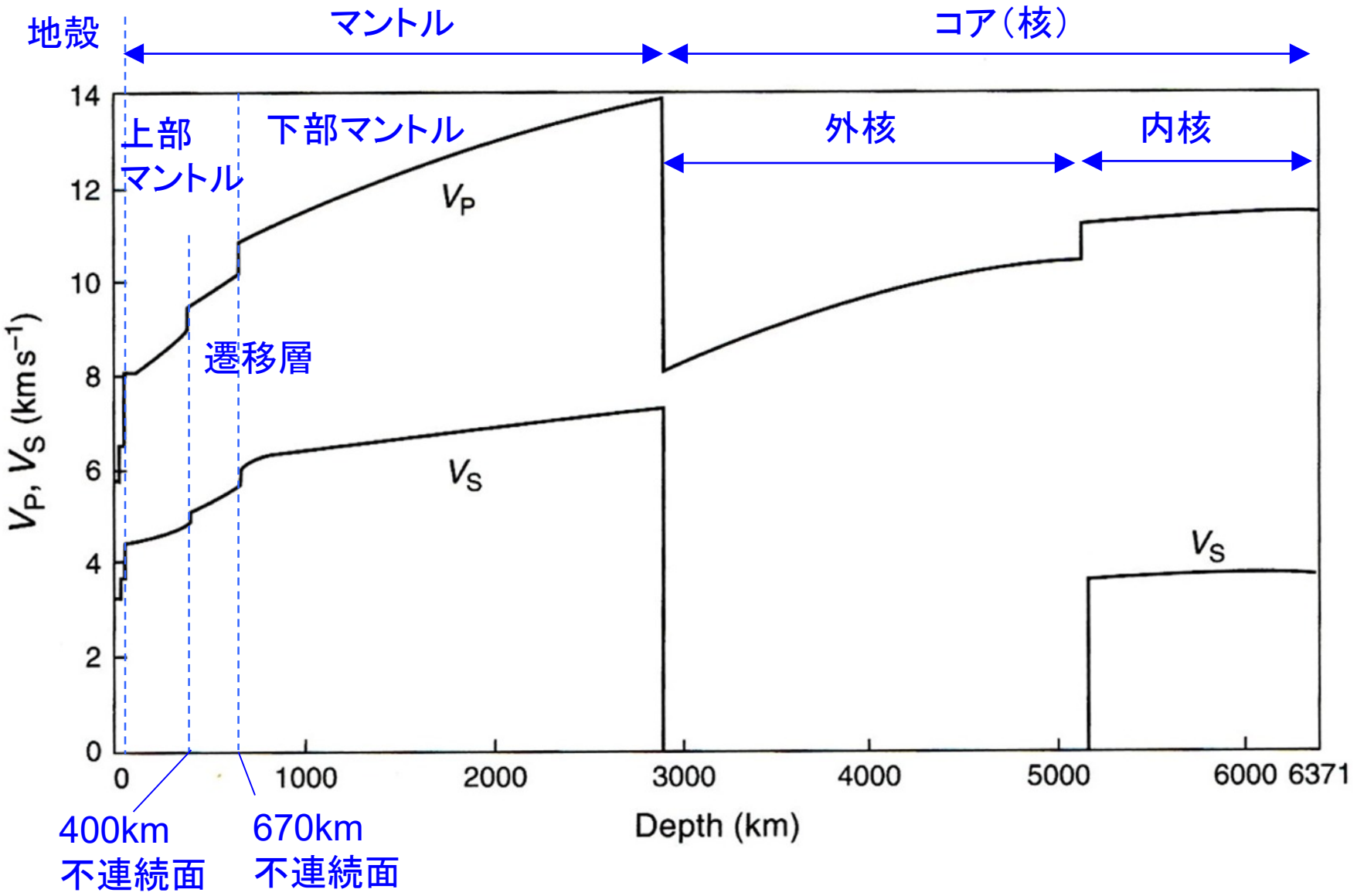
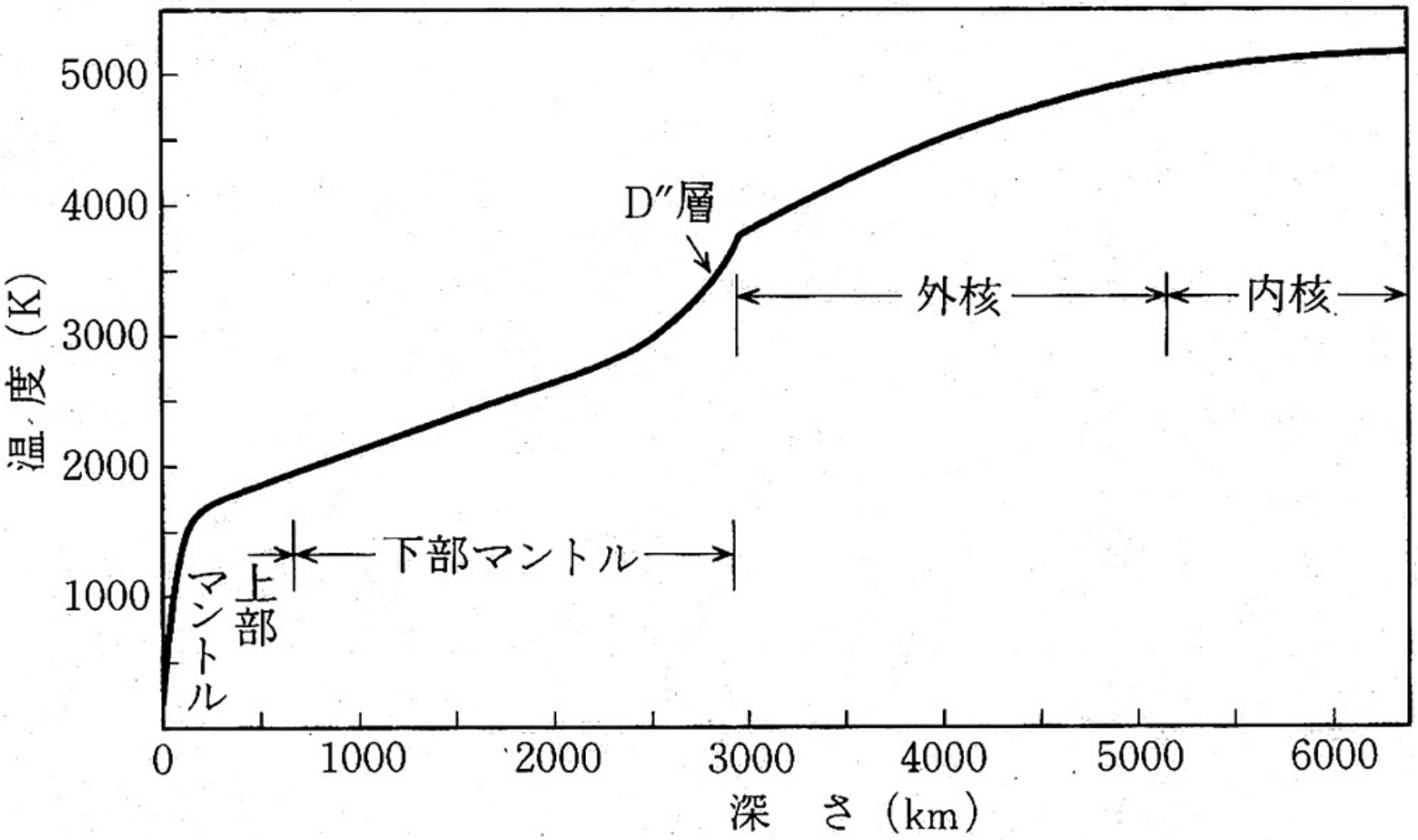
地球内部物理学

2020.1.10

球対称地球モデル

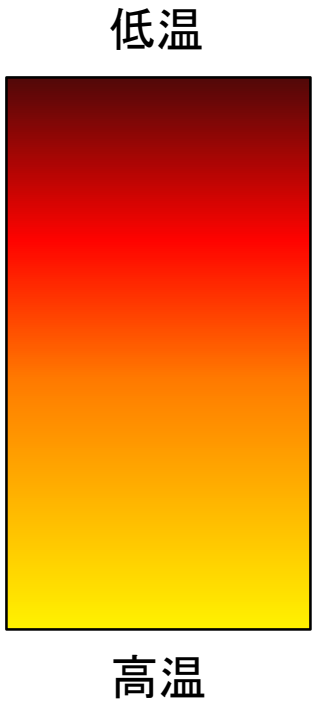
IASP91




5000
4000
3000
2000
1000
温度（K）
D″層
外核
内核
下部マントル
上部マントル
0
1000
2000
3000
4000
5000
6000
深　さ（km）

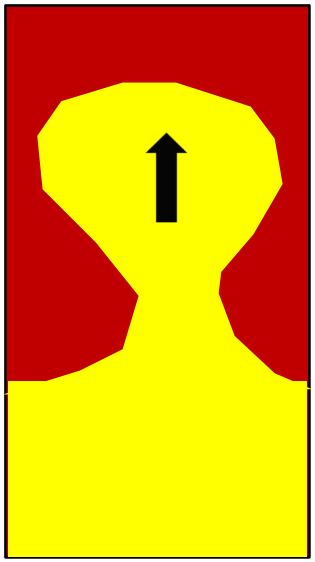
熱輸送のメカニズム

伝導



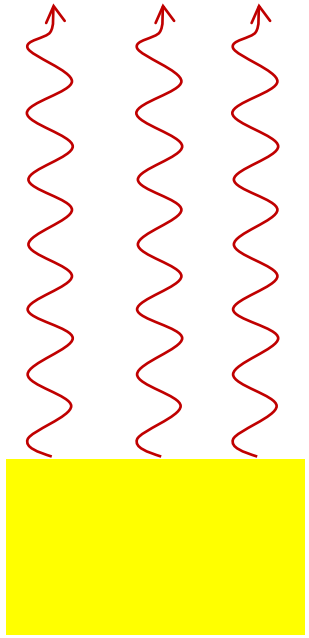
原子，分子の熱振動が伝播する

移流



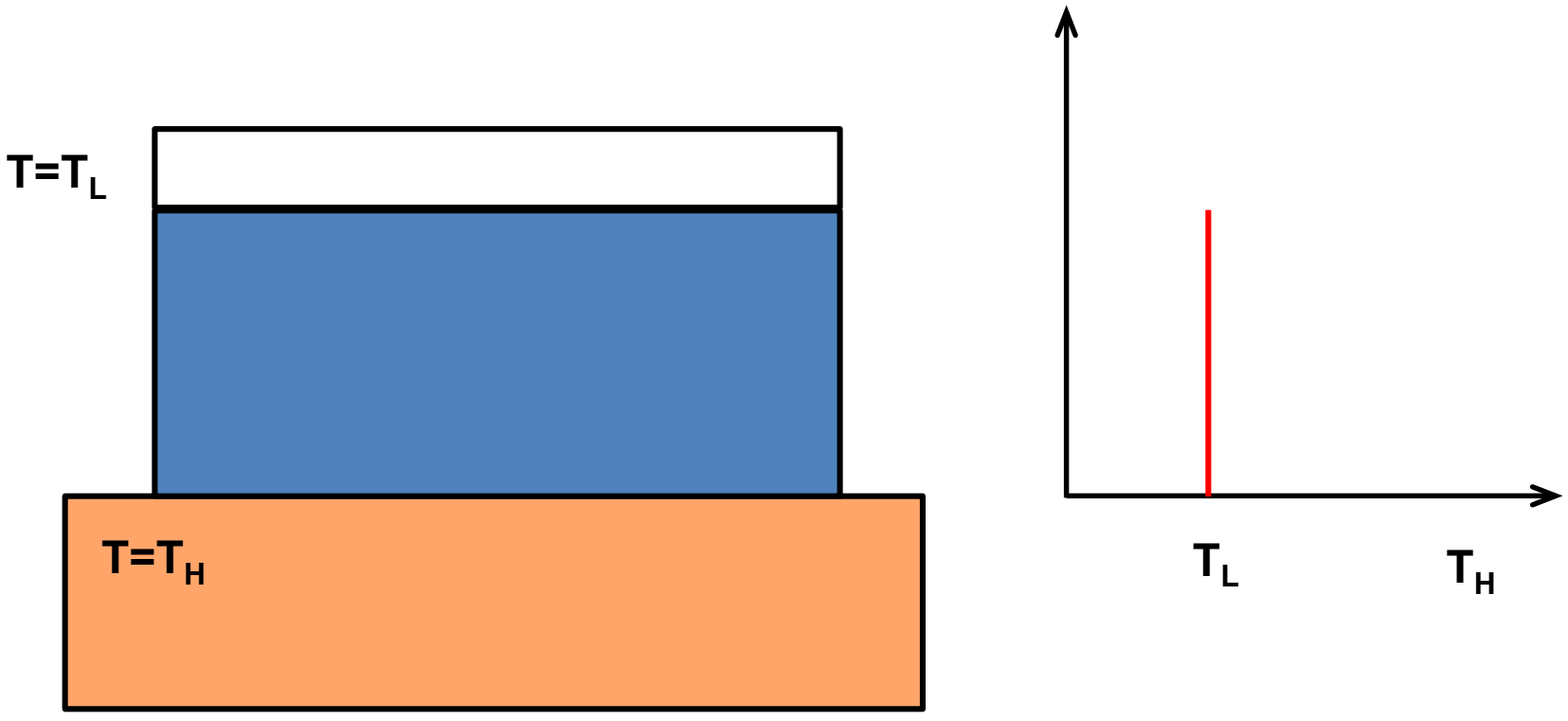
媒質自体が運動して熱を輸送する

放射



電磁波でエネルギーを輸送する

なべに入った水を熱すると．．．



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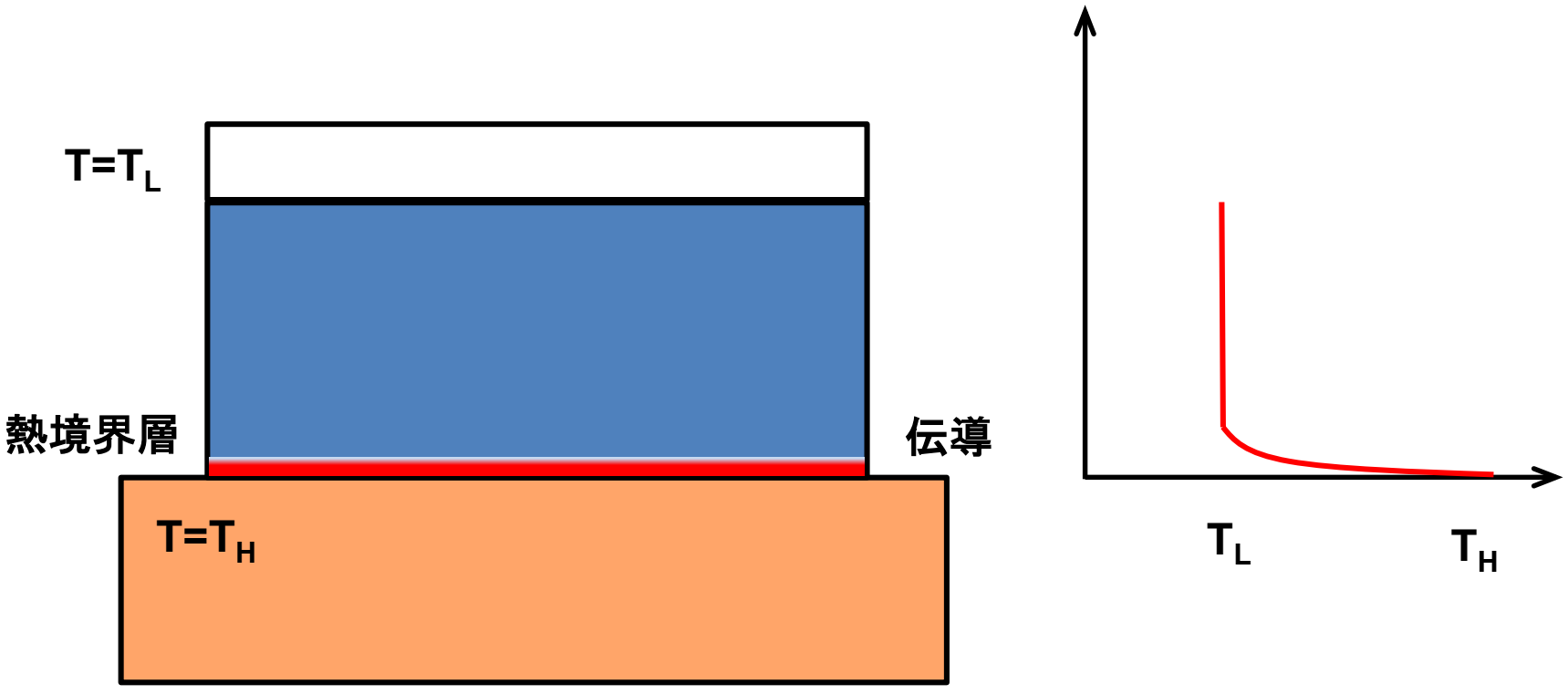

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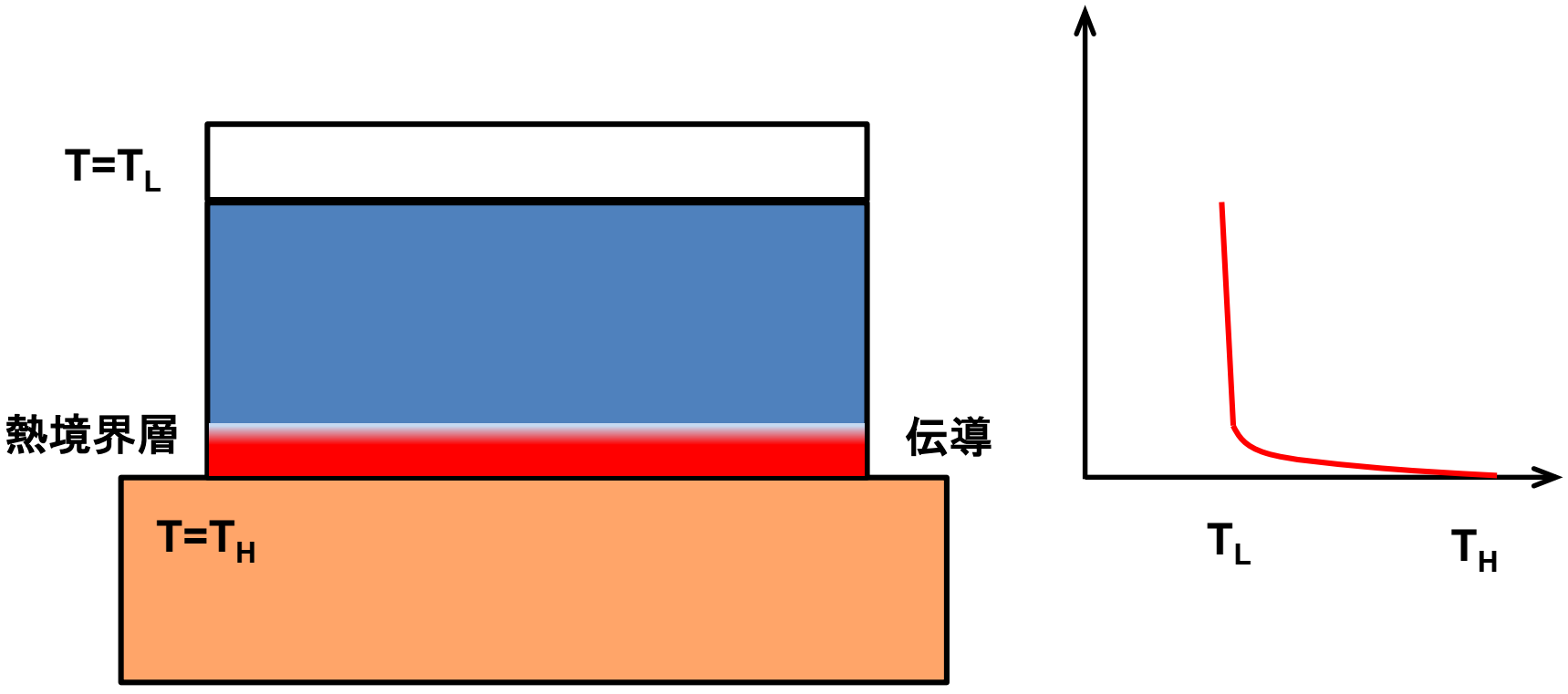
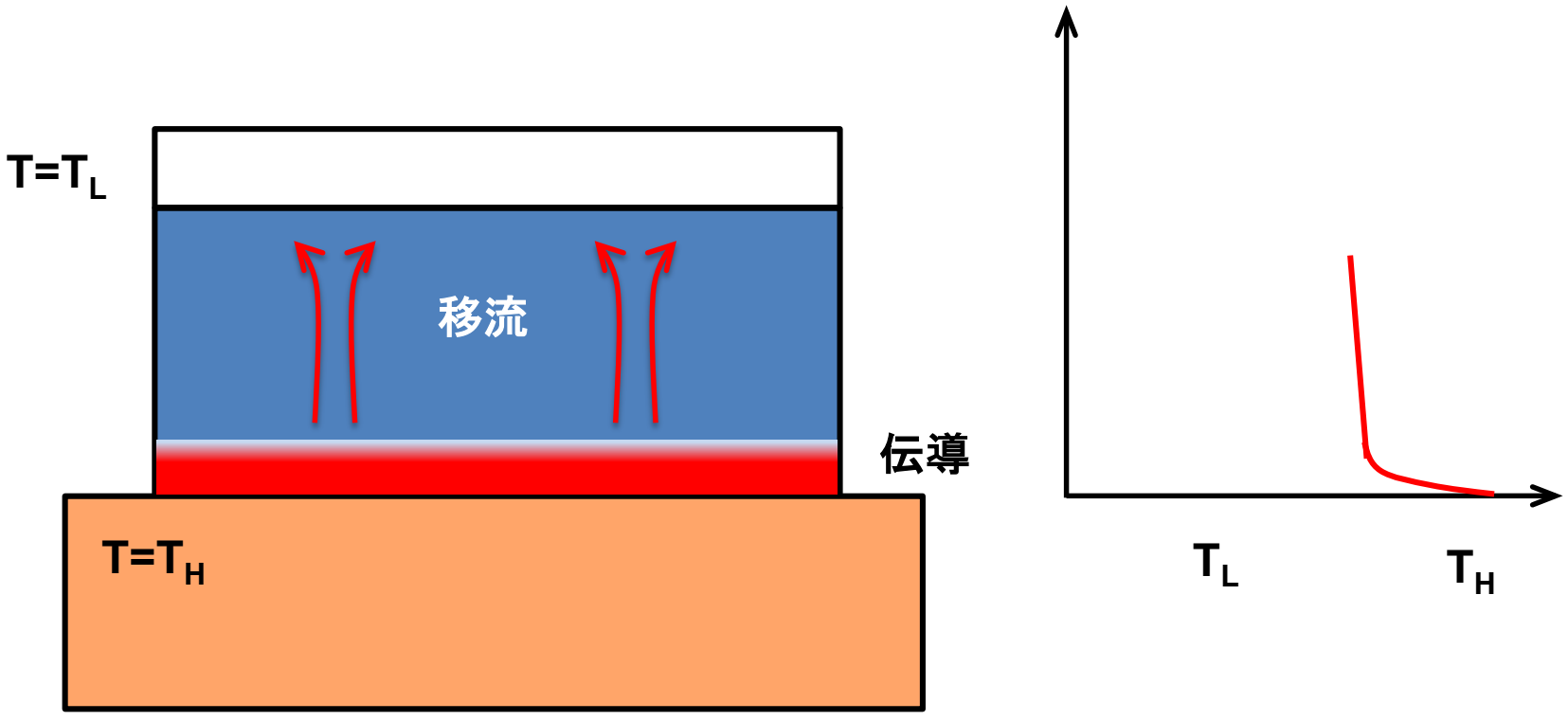
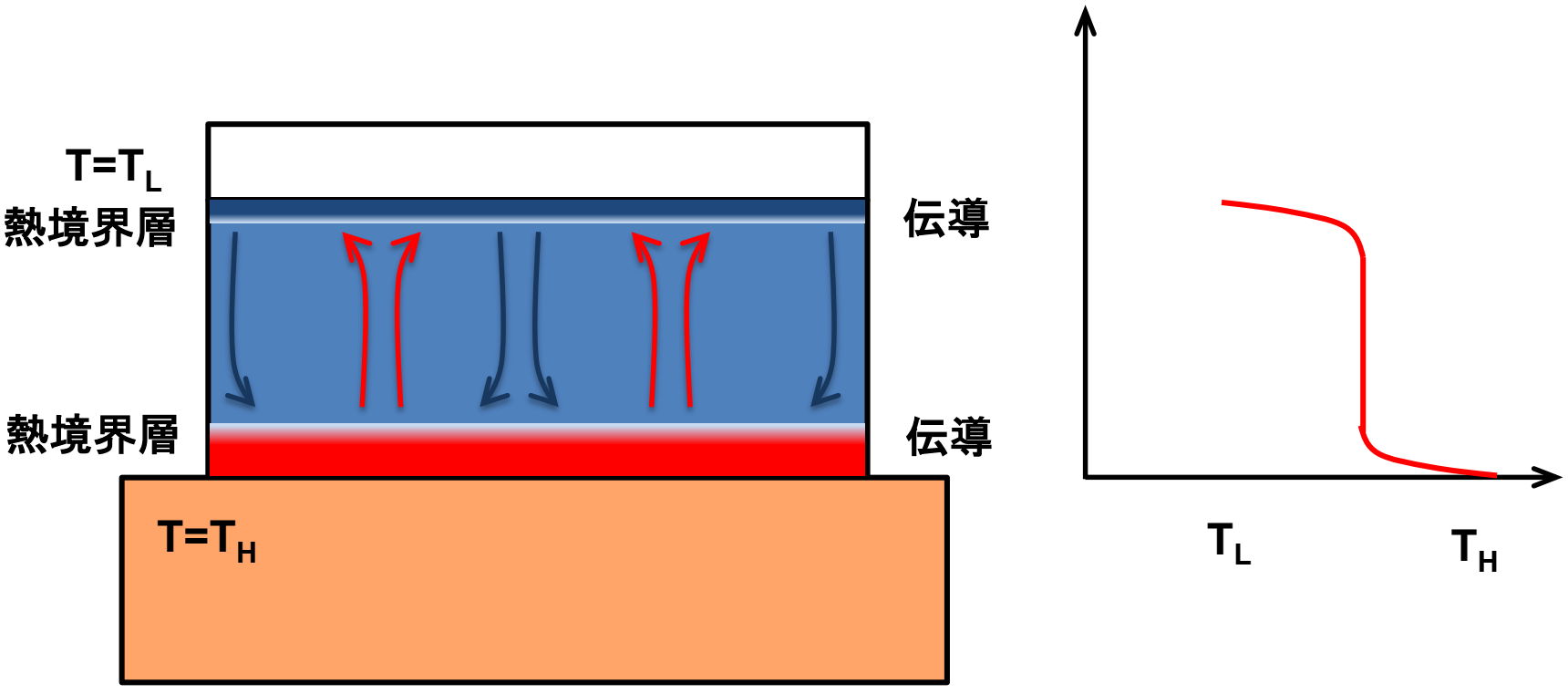


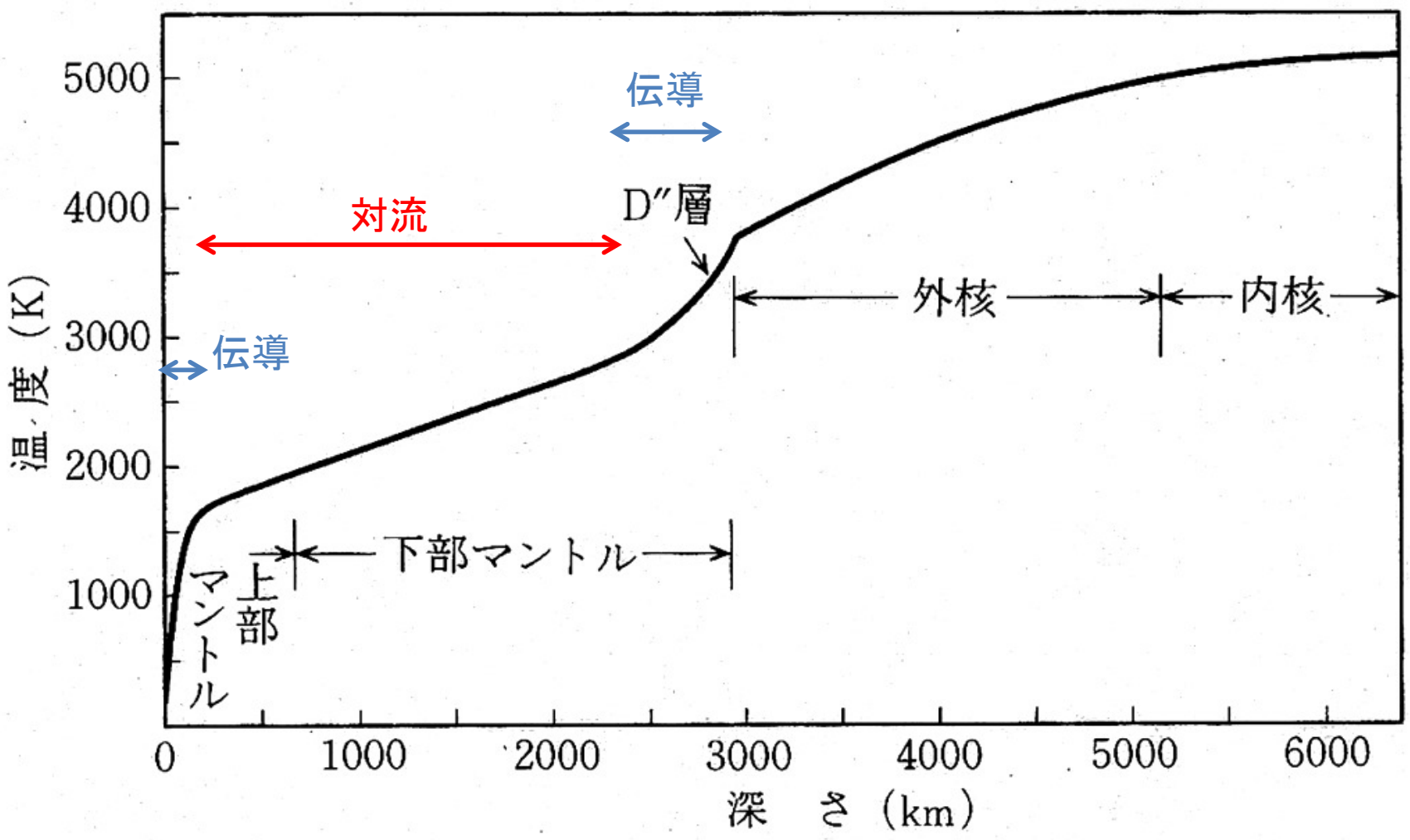
なべに入った水を熱すると．．．



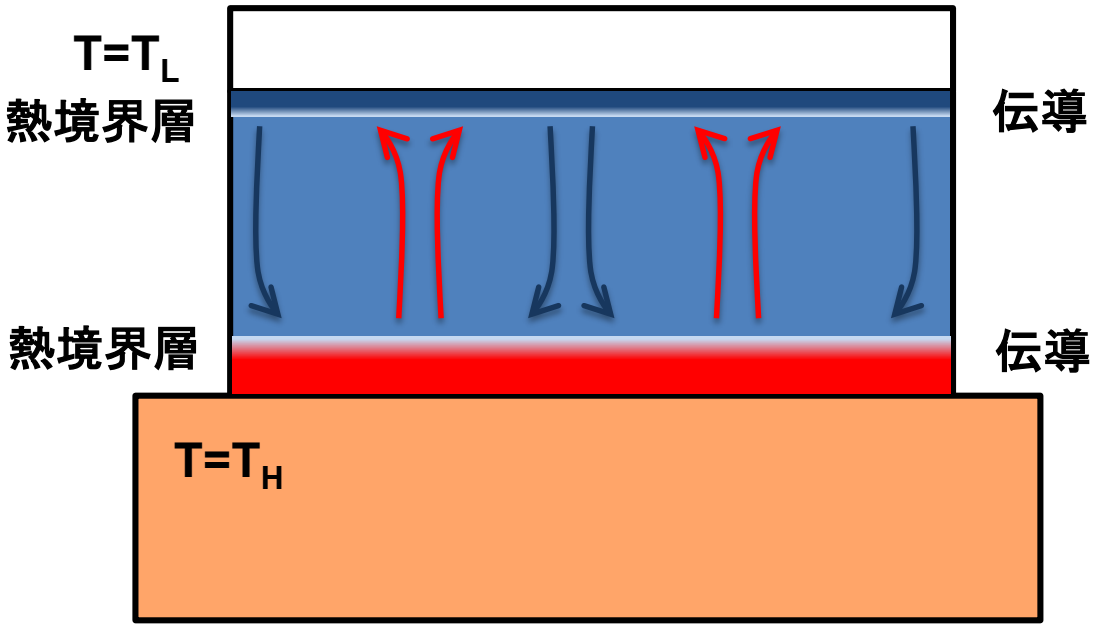
対流が起きているとすると. . .



地球内部の温度

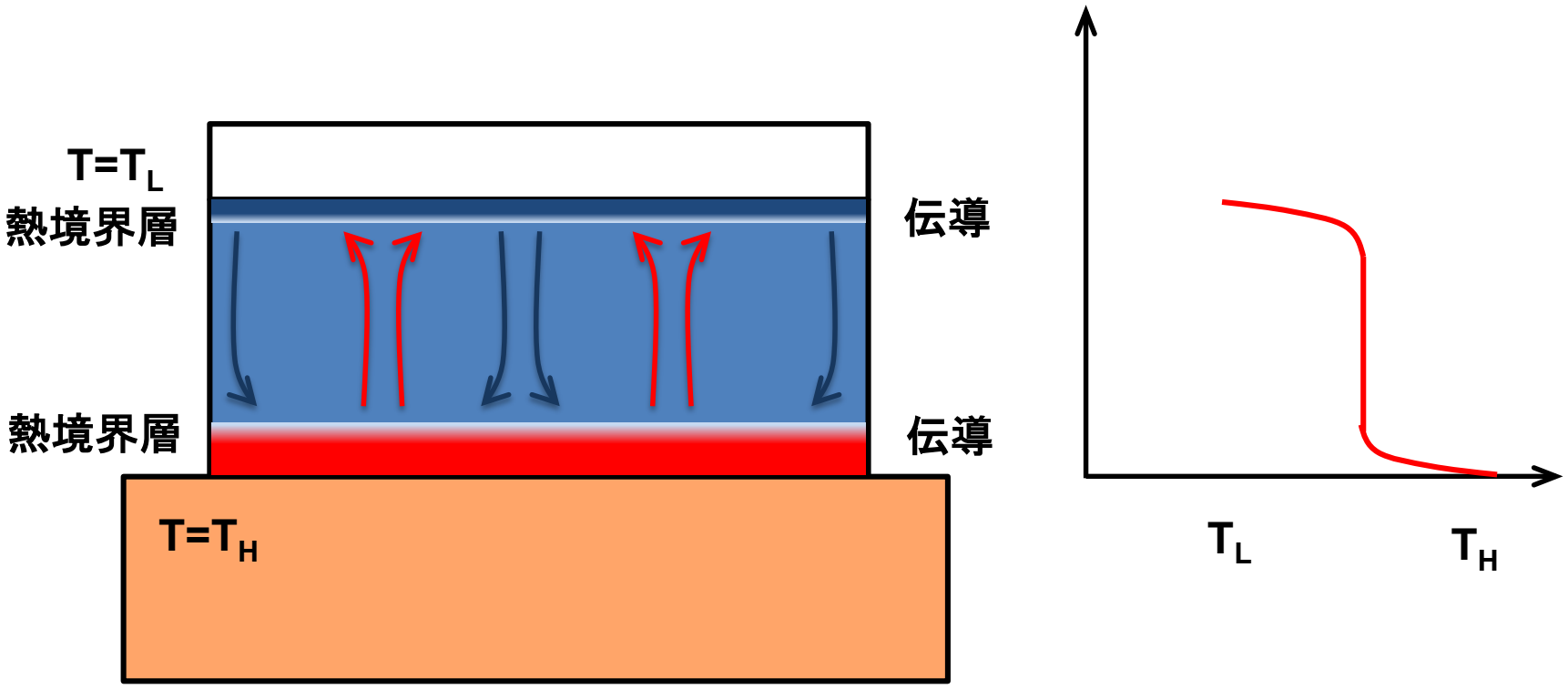

5000
4000
3000
2000
1000
温度（K）
伝導
対流
D″層
伝導
外核
内核
マントル
上部
下部マントル
0
1000
2000
3000
4000
5000
6000
深　さ（km）

対流が起きるための条件は？



対流が起きているとすると. . .

上昇流と下降流の部分で温度が違うはず
⇒　地震波速度が違うはず



球対称地球モデル

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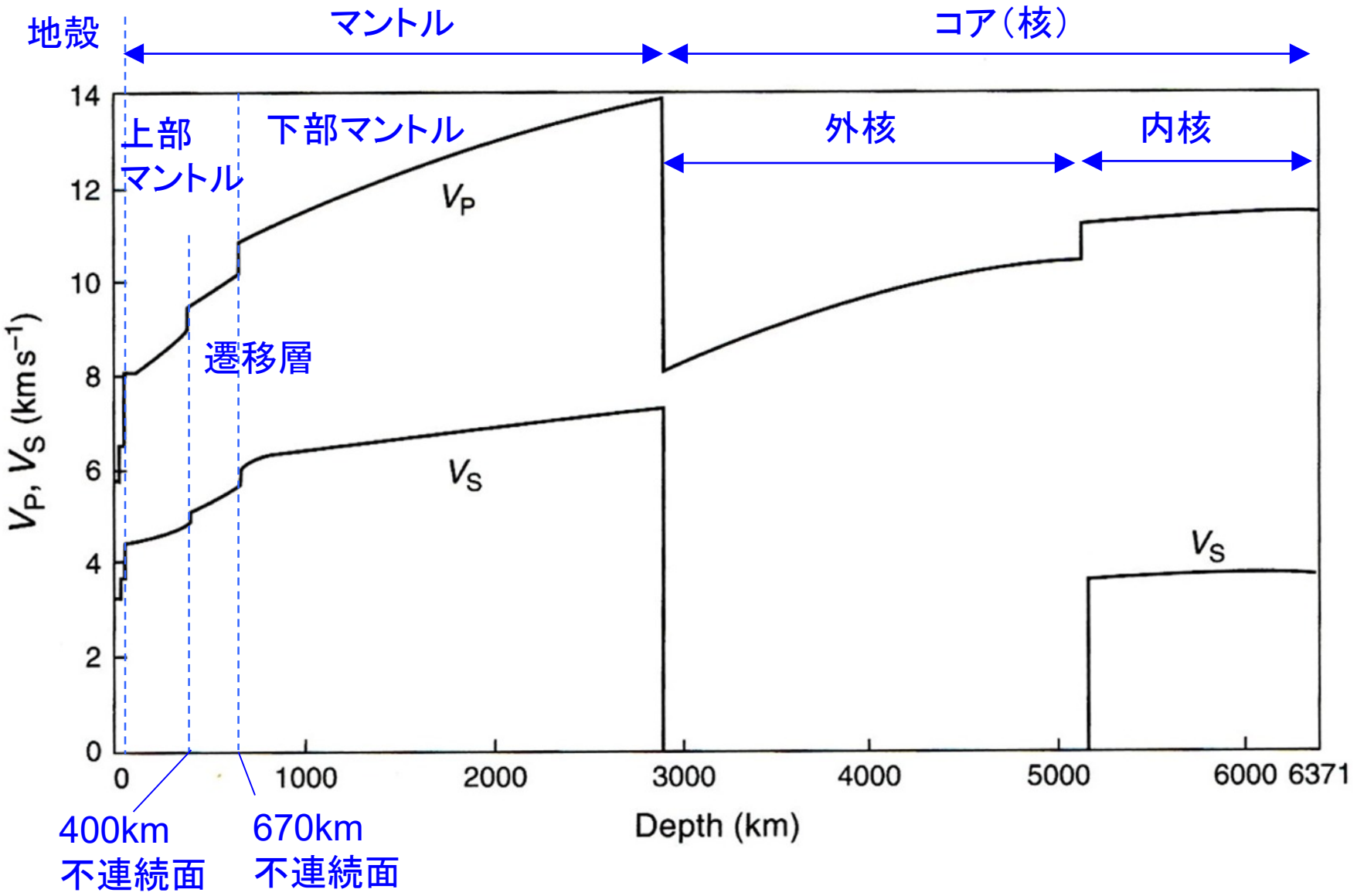
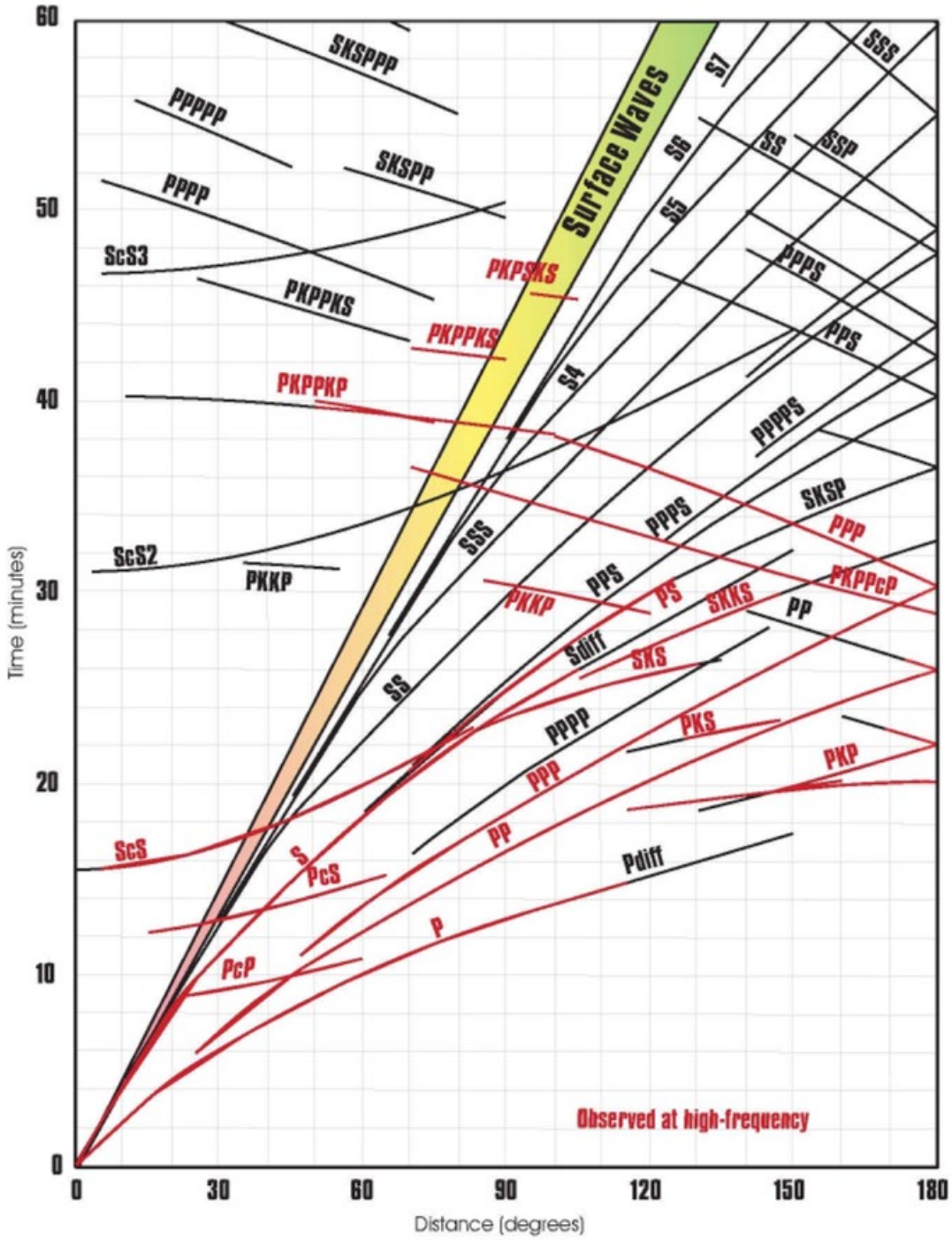


IASP91に基づいた
理論走時



PKIKP

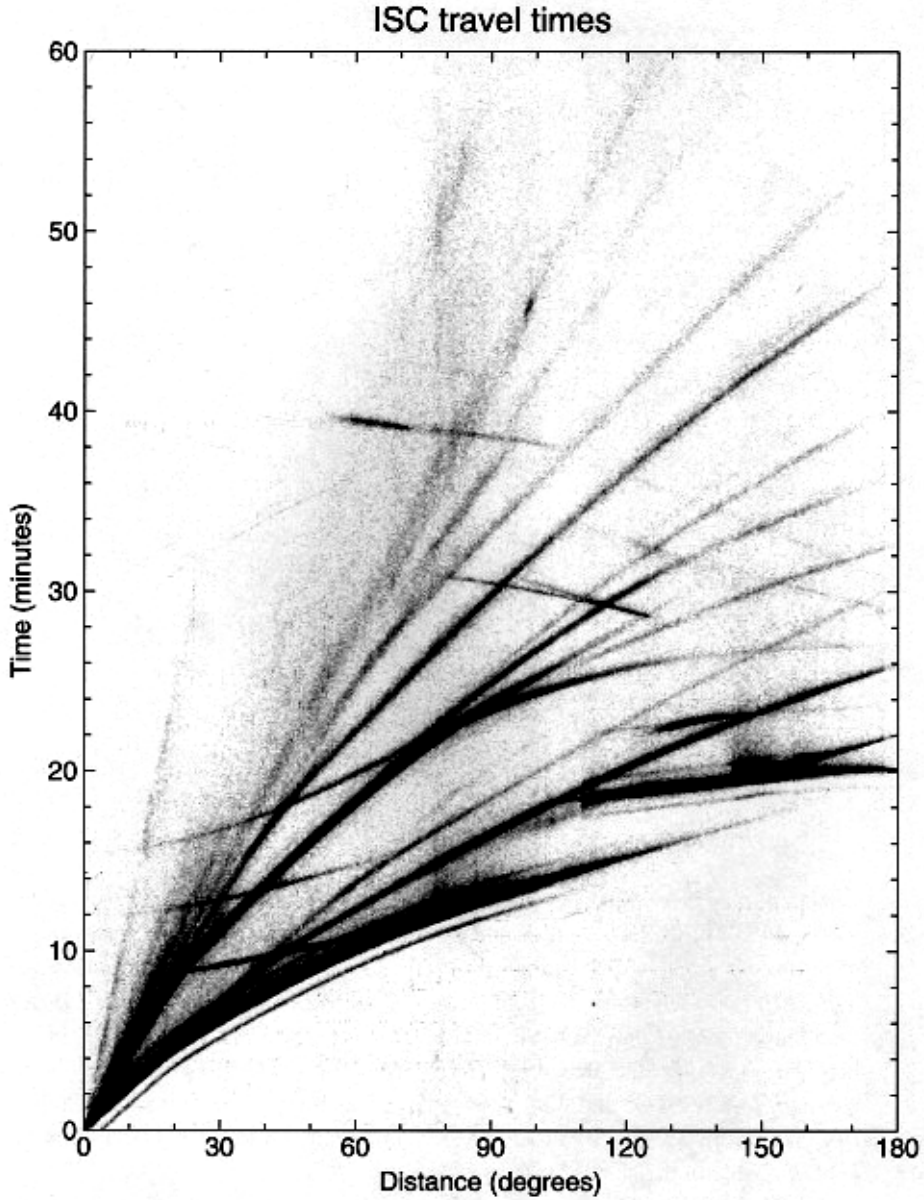
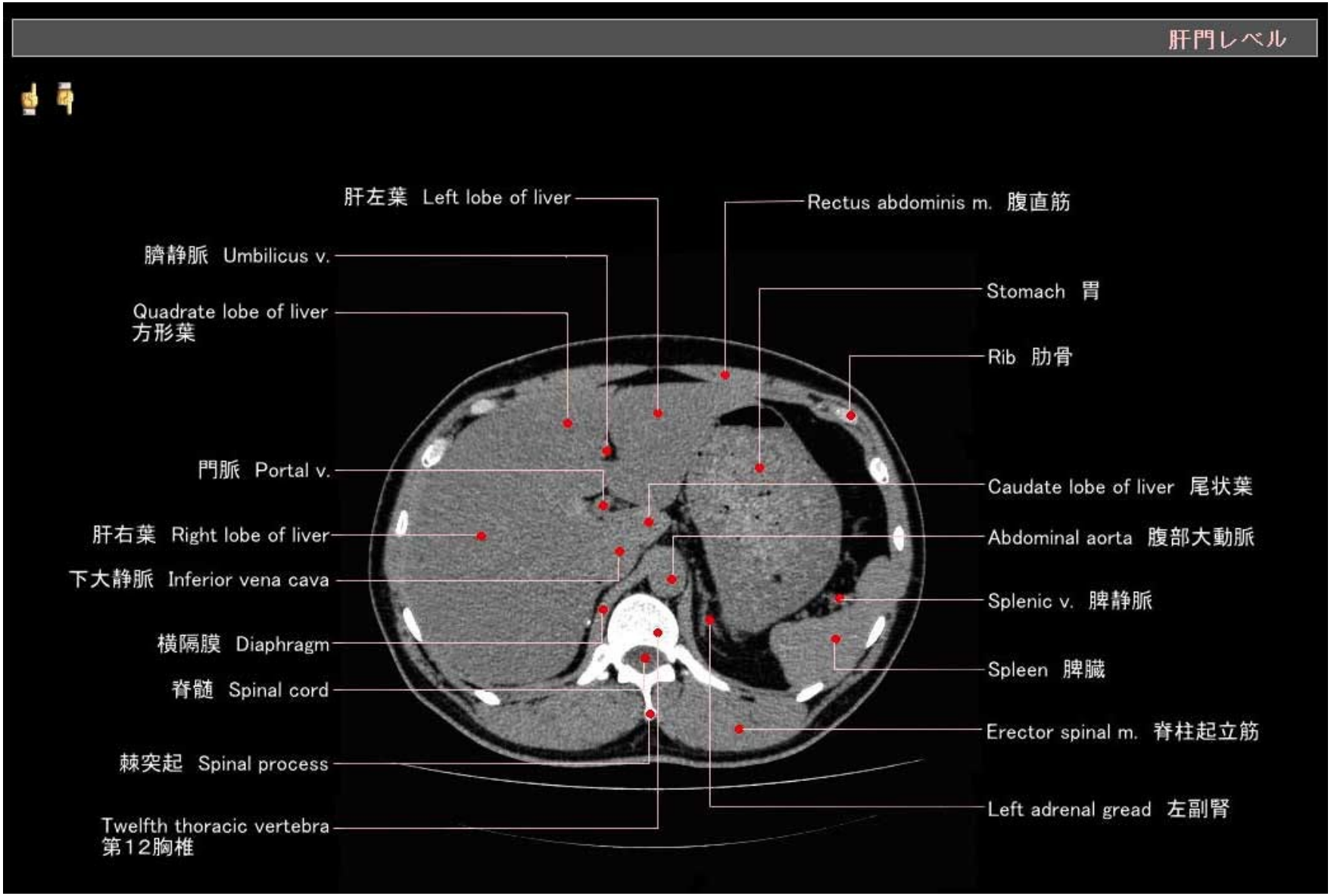


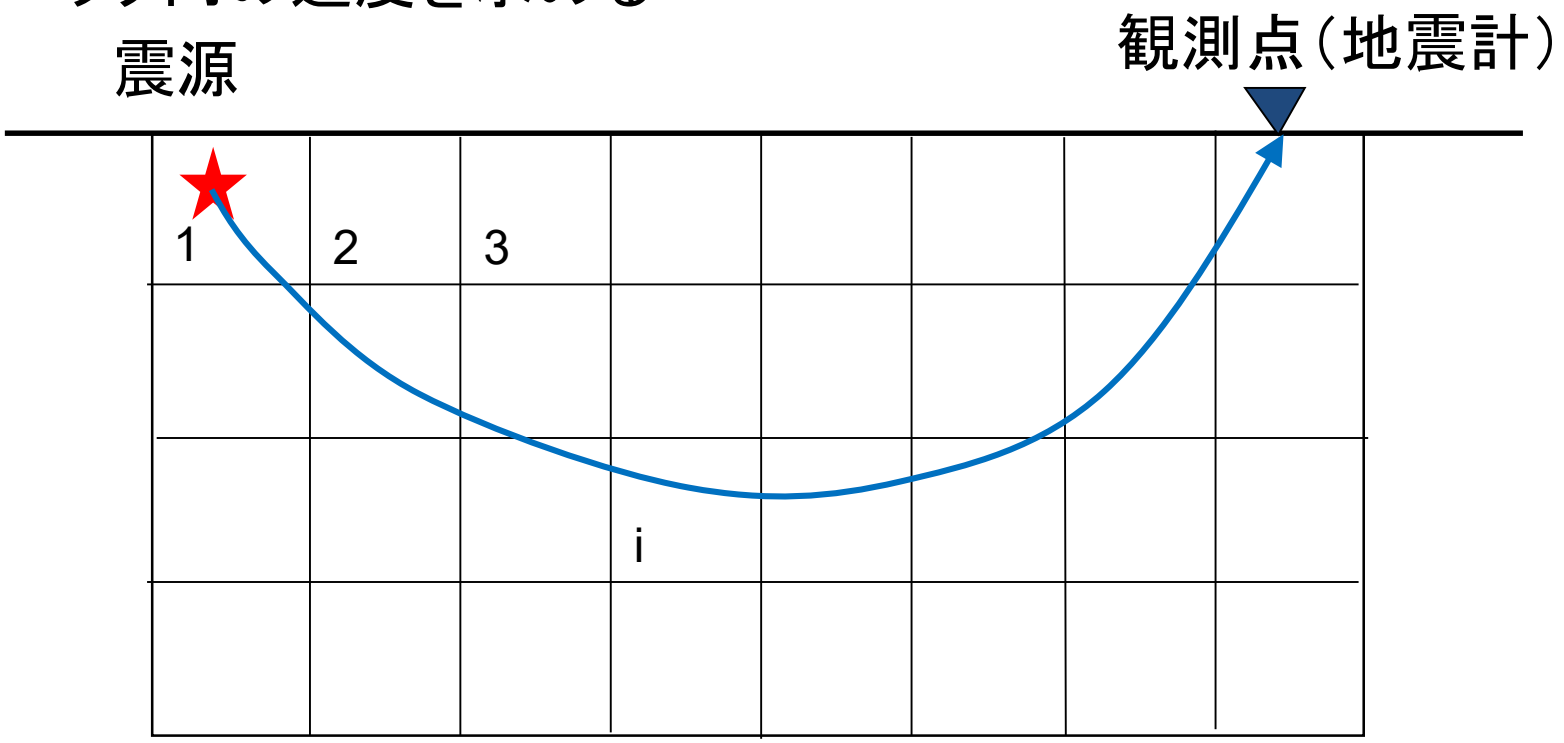
Fig. 4.17. Travel time picks collected by the ISC between 1964 and 1987 for events shallower than 50 km. Over five million individual picks are plotted, the bulk of which are *P*, *PKP*, and *S* arrivals. However, several later arriving branches can also be seen, including *PP*, *PKS*, *PcP*, *PcS*, *ScS*, *PKKP*, and *PKPPKP*. See Figures 4.19 and 4.23 for a key to the phase names. The phases visible at ±1 minute from the *P*-wave are due to errors in assigning times.

X線CT


肝門レベル
肝左葉 Left lobe of liver
臍静脈 Umbilicus v.
Quadrate lobe of liver
方形葉
門脈 Portal v.
肝右葉 Right lobe of liver
下大静脈 Inferior vena cava
横隔膜 Diaphragm
脊髄 Spinal cord
棘突起 Spinal process
Twelfth thoracic vertebra
第12胸椎
Rectus abdominis m. 腹直筋
Stomach 胃
Rib 肋骨
Caudate lobe of liver 尾状葉
Abdominal aorta 腹部大動脈
Splenic v. 脾静脈
Spleen 脾臓
Erector spinal m. 脊柱起立筋
Left adrenal gread 左副腎

水平方向不均質を探る:トモグラフィ

各ブロック内の速度を求める



理論走時

$$T = \sum_i \frac{x_i}{v_i}$$

トモグラフィの原理

震源ー観測点の組が十分あれば v_i が求められる

$$T^1 = \frac{x^1{}_1}{v_1} + \frac{x^1{}_2}{v_2} + \frac{x^1{}_3}{v_3} + \ldots + \frac{x^1{}_n}{v_n}$$

$$T^2 = \frac{x^2{}_1}{v_1} + \frac{x^2{}_2}{v_2} + \frac{x^2{}_3}{v_3} + \ldots + \frac{x^2{}_n}{v_n}$$

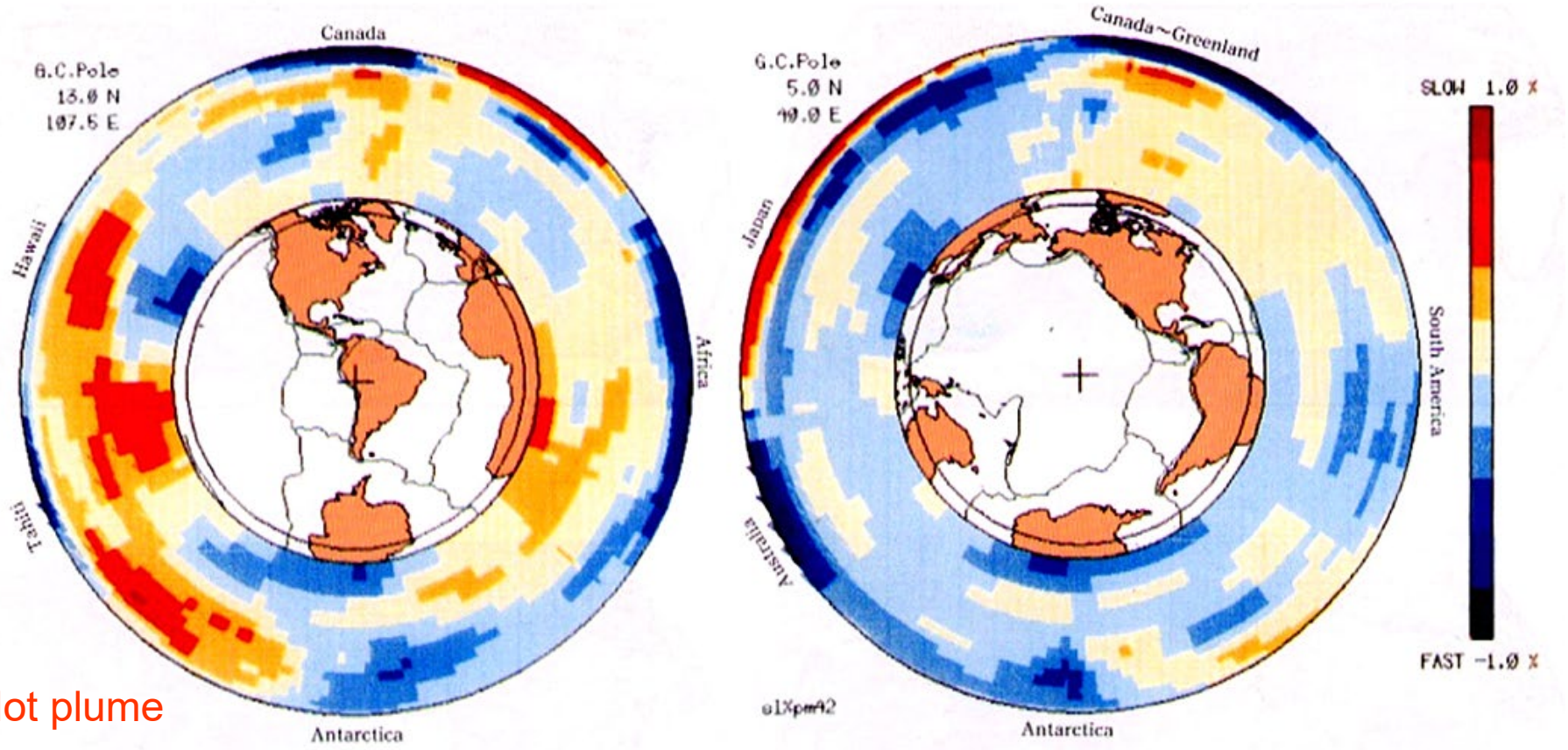
.....

$$T^k = \frac{x^k{}_1}{v_1} + \frac{x^k{}_2}{v_2} + \frac{x^k{}_3}{v_3} + \ldots + \frac{x^k{}_n}{v_n}$$

T^k, $x^k{}_i$ は既知

密な観測網，　高速計算機が必要

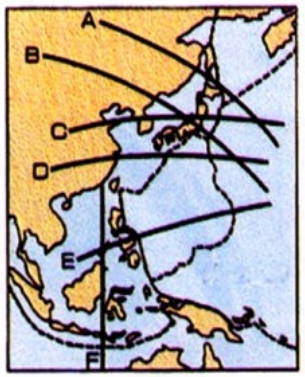
全マントル・トモグラフィ



Hot plume

Fukao et al. (1994)

プレート: 滞留した後，下部マントルを下降



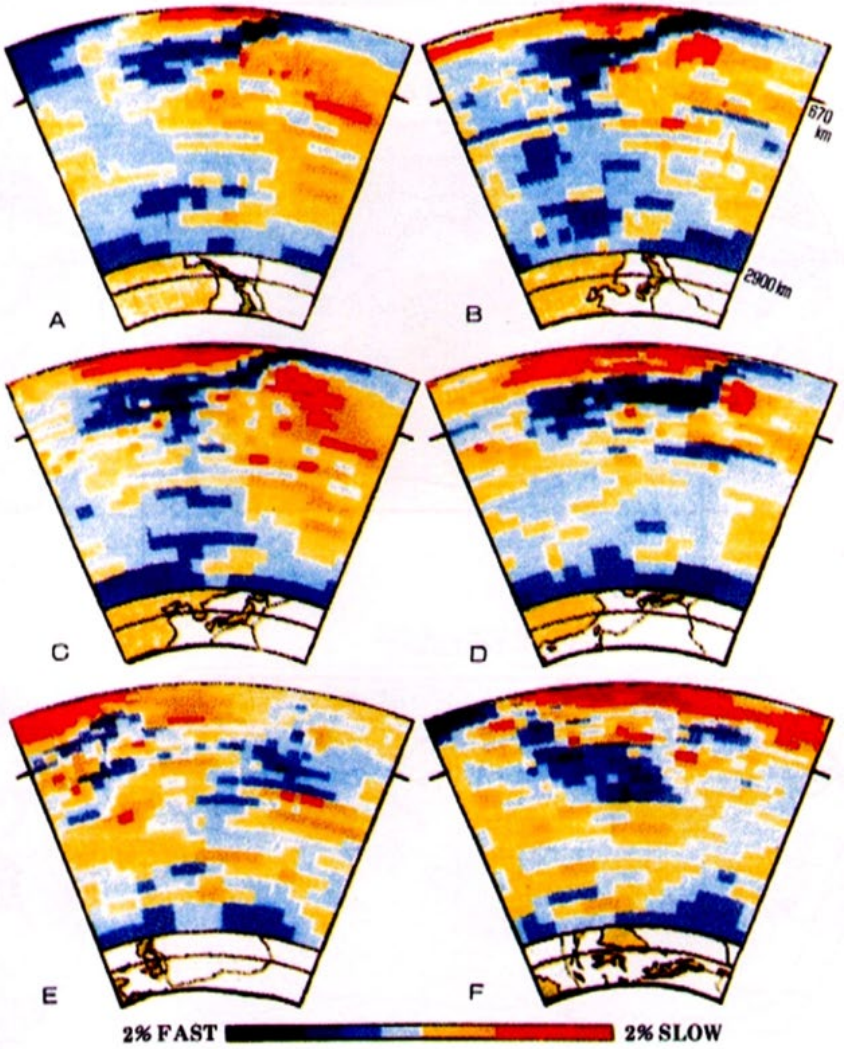


Fig. 17. Above : representative cross sections of P-wave velocity perturbations in the mantle along great circles. The position of cross section is shown as a circle in an inset world map. The scale of anomaly is as same as Fig. 16. Below : Two contrasting modes of occurrence of subducted slabs in the western Pacific region. Cross sections of the slowness anomalies in the mantle along the profiles shown in the inset map. Subducted slabs are stagnant right above 670 km discontinuity plane around Japan (A, B, C, D, and E), but are being sunken in the Sunda region (F).

Fukao et al. (1994)