# 令和３年度（2021 年度）

# 東北大学大学院理学研究科　地学専攻

# 博士課程前期２年の課程　入試問題

## 英語

令和 2 年 8 月 27 日　10：00 ～ 11：20 実施

### 注 意 事 項

（1）机の上には、受験票、筆記用具、時計以外は置かないこと。
（2）携帯電話や音の出る機器などは、電源を切ってかばんの中に入れること。
（3）試験開始の合図があるまで、この冊子を開かないこと。
（4）試験中大きな地震が発生した場合、試験監督の指示に従うこと。
（5）問題は、英語 1～2 の大問２問からなる。解答は解答用紙の指定されたところに記入すること。

**英語 1**　次の英文を読み、以下の問 1～2 に日本語で答えよ。

(a) In the 1960s, a great revolution in thinking shook the world of geology. For almost 200 years, geologists had been developing various theories of tectonics—the general term used to describe mountain building, volcanism, earthquakes, and other processes that construct geologic features on Earth's surface. It was not until the discovery of plate tectonics, however, that a single theory could satisfactorily explain the whole range of geologic processes. Physics had a comparable revolution at the beginning of the twentieth century, when the theory of relativity revised the physical laws that govern space, time, mass, and motion. Biology had a similar revolution in the middle of the twentieth century, when the discovery of DNA allowed biologists to explain how organisms transmit the information that controls their growth and functioning from generation to generation.

The basic ideas of plate tectonics were put together as a unified theory of geology about 50 years ago. The scientific synthesis that led to the theory of plate tectonics, however, really began much earlier in the twentieth century, with the recognition of evidence for continental drift.

*Continental Drift*

The concept of continental drift—large-scale movements of continents—has been around for a long time. In the late sixteenth century and in the seventeenth century, European scientists noticed the jigsaw-puzzle fit of the coasts on both sides of the Atlantic Ocean, as if the Americas, Europe, and Africa had once been part of a single continent and had subsequently drifted apart. By the close of the nineteenth century, the Austrian geologist Eduard Suess had put together some of the pieces of the puzzle. He postulated that the present-day southern continents had once formed a single giant continent called *Gondwana* (or *Gondwanaland*). In 1915, Alfred Wegener, a German meteorologist who was recovering from wounds suffered in World War I, wrote a book on the breakup and drift of continents, in which he laid out the remarkable similarity of geologic features on opposite sides of the Atlantic. In the years that followed, Wegener postulated a supercontinent, which he called Pangaea, that broke up into the continents as we know them today.

Although Wegener was correct in asserting that the continents had drifted apart, his

hypotheses about how fast they were moving and what forces were pushing them across Earth's surface turned out to be wrong, as we will see, and those errors reduced his credibility among other scientists. After about a decade of spirited debate, physicists convinced geologists that Earth's outer layers were too rigid for continental drift to occur and Wegener's ideas were rejected by all but a few geologists.

Wegener and other advocates of the drift hypothesis pointed not only to the geographic matching of geologic features but also to similarities in rock ages and trends in geologic structures on opposite sides of the Atlantic. They also offered arguments, accepted now as good evidence of drift, based on fossil and climate data. Identical 300-million-year-old fossils of the reptile *Mesosaurus*, for example, have been found in Africa and in South America, but nowhere else, suggesting that the two continents were joined when *Mesosaurus* was alive. The animals and plants on the different continents showed similarities in their evolution until the postulated breakup time. After that, they followed different evolutionary paths because of their isolation and changing environments on the separating continents. In addition, rocks deposited by glaciers that existed 300 million years ago were found distributed across South America, Africa, India, and Australia. If these southern continents had once been part of Gondwana near the South Pole, a single continental glacier could account for all of these glacial deposits.

*Seafloor Spreading*

(b)The geologic evidence did not convince the skeptics, who maintained that continental drift was physically impossible. No one had yet come up with a plausible driving force that could have split Pangaea and moved the continents apart. Wegener, for example, thought the continents floated like boats across the solid oceanic crust, dragged along by the tidal forces of the Sun and Moon. His hypothesis was quickly rejected, however, because it could be shown that tidal forces are much too weak to move continents.

The breakthrough came when scientists realized that convection in Earth's mantle could push and pull continents apart, creating new oceanic crust through the process of seafloor spreading. In 1928, the British geologist Arthur Holmes proposed that convection currents "dragged the two halves of the original continent apart, with consequent mountain building in the front where the currents are descending, and the ocean floor development on the site of the gap, where the currents are ascending." Many

still argued, however, that Earth's crust and mantle are rigid and immobile, and Holmes conceded that "purely speculative ideas of this kind, specially invented to match the requirements, can have no scientific value until they acquire support from independent evidence."

That evidence emerged from extensive explorations of the seafloor after World War II. Marine geologist Maurice "Doc" Ewing showed that the seafloor of the Atlantic Ocean is made of young basalt, not old granite, as some geologists had previously thought. Moreover, the mapping of an undersea mountain chain called the Mid-Atlantic Ridge led to the discovery of a deep crack-like valley, or *rift*, running down its crest. Two of the geologists who mapped this feature were Bruce Heezen and Marie Tharp, colleagues of Doc Ewing at Columbia University. “I thought it might be a rift valley," Tharp said years later. Heezen initially dismissed the idea as "girl talk," but they soon found that almost all earthquakes in the Atlantic Ocean occurred near the rift, confirming Tharp's hunch. Because most earthquakes are generated by faulting, their results indicated that the rift was a tectonically active feature. Other mid-ocean ridges with similar rifts and earthquake activity were found in the Pacific and Indian oceans.

In the early 1960s, Harry Hess of Princeton University and Robert Dietz of the Scripps Institution of Oceanography proposed that Earth's crust separates along the rifts in mid-ocean ridges, and that new crust is formed by the upwelling of hot molten rock into these cracks. The new seafloor—actually the surface of newly created lithosphere—spreads laterally away from the rifts and is replaced by even newer crust in a continuing process of plate creation.

（John Grotzinger and Tom Jordan, *Understanding the Earth (6th Edition)*より抜粋）

注）shook：shake の過去形、*Mesosaurus*：メソザウルス（海棲爬虫類の一種）、
hunch：直感

問 1 下線部 (a) および (b) を和訳せよ。

問 2 ウェゲナー（Wegener）と彼の擁護者が大陸漂移説の証拠としてあげた事実を全て挙げよ。

**英語 2**　あなたの卒業研究の目的と背景を英語で 10 行以内で述べよ。卒業研究課題がない場合は、進学後の研究（予定）の目的と背景を述べること。なお、採点に際しては、英語が的確に書かれているかのみを評価し、科学的な内容は評価の対象としない。