ZUSAMMENFASSUNG

Einer der frühesten Triumphe der globalen vergleichenden Tektonik ist die Anerkennung eines unregelmässigen Wanderns der Orogenese von zentralen Kratonen gegen die Ränder der Kontinente gewesen, welches Suess als irregulären kontinentalen Wachstum deutete. Die Kontinentaldrifttheorie, geschmiedet durch Argands Genius in eine, den Forderungen der kontinentalen Tektonik entsprechende Form, gab die erste befriedigende Erklärung des peripheren kontinentalen Wachstums und warum dieser unregelmässig vor sich gehen sollte. Obwohl der kompliziert zusammengesetzte Aufbau der Kontinente im Rahmen der Plattentektonik eine einfache Erklärung fand, wurden die kontinentalen Kollisionszonen rasch in die Naht*linien* ("Synaphien") von Salomon-Calvi stereotypisiert, ungeachtet des Fehlens solcher Indus-Sutur-ähnlicher Linien in vielen orogenen Gürteln, wo die Kollisionszonen durch breite Anhäufungen früherer Akkretionskeile markiert sind. Trotz seiner subduktionslosen Auffassung der kontinentalen Wanderungen hat Argand die Wichtigkeit solchen angehäuften ozeanischen Materials anerkannt. Er stellte sie in Karten und Profilen zeichnerisch dar und hob den Unterschied zwischen diesen und den linearen Nahtzonen implizit hervor.

Wie bereits von Argand erkannt, befinden sich viele Beispiele grosser Akkretionskeile in der Architektur Asiens. Dominant sind sie in der Struktur der Altaiden und spielen auch eine nicht unbedeutende Rolle in den Kimmeriden. Eine untergeordnete Stellung nehmen sie nur im orogenen Aufbau der Alpiden ein. Existenz und Ausmass der Akkretionskomplexe scheinen eine Funktion der Grösse des abgeführten Ozeans und der Sedimentzufuhr zu sein.

Das Vorhandensein gewaltiger Akkretionskeile im Aufbau der kontinentalen Kruste hat sehr wichtige Implikationen für die Struktur und die Zusammensetzung der unteren Kruste, für die Beschaffenheit der krustalen Anisotropien und für das allgemeine Wachstum der Kontinente.

1. Introduction

The purpose of this paper is to present some speculations on how the continental crust may have been constructed through the accumulation, and consolidation by magmatism and metamorphism, of accretionary wedges formed during the destruction of oceans. This is related below on Asiatic examples and within the framework of an historical sketch of the evolution of the relevant ideas, in which Emile Argand appears as the leading actor with his prophetic pronouncements on the tectonics of Asia. The speculations we develop suggest answers to such questions as to why in some places the lower continental crust may consist of up to 90% of pelitic material (e.g. Reid et al. 1989, p. 378 and the references cited therein); why the lower crust is seen commonly to be complexly layered (e.g. Brown et al. 1986); and why in Central Asia suture *lines* similar to the one along the Indus and the Yarlung Zangbo in the Himalaya (Gansser 1980) are so rare. All these features seem to result from the widespread occurrence of an hitherto little-considered type of an orogenic belt, in which accretionary wedges are by far the most dominant component. Owing to its prevalence in the structure of areas in Asia inhabited almost exclusively by Turkic peoples[4]), Şengör (in press) called this type of orogenic belt the *Turkic-type* (see also footnote 18 below). The Turkic-type

[4]) The Turkic peoples are those that are historically and linguistically connected with the T'u-chüeh, a name given by the Chinese to a nomadic people who in 552 AD founded under the leadership of Bumin Khagan a vast empire that stretched from the upper course of the Amur River to the Black Sea and that covered much of the area of the Altaids and the Cimmerides (cf. Şengör 1987 and Fig. 1). Although the earlier Hsiung-nu (the *Kun*, probably originally meaning "man") who had founded a similar empire under Mao-tun in the second century B.C. were also Turkic, the T'u-chüeh were the first Turkic people to leave a written record. In addition to the Turks of the present-day Turkey, the Uzbek, the Kazakh, the Kirgiz, the Turkmen, the Yakut and the Uighur (Uygur) constitute, among others, the most important Turkic peoples.

orogenic belts form, upon collision, a species of the superfamily of non-continental-override-type collisional orogens (NCOB or Himalayan-type) in ŞENGÖR's (1990a, table II) classification.

In the following paragraphs we first review the history of ideas that led to Argand's model of accretion and continental growth through continental drift (Part I), and then discuss accretion tectonics and the enlargement of continents in the framework of our view of the widespread occurrence of Turkic-type orogenic belts as a tribute to the enormous insight Argand had into accretionary tectonics (Part II).

PART I

2. Argand's predecessors in the study of continental growth[5])

A long-held view in geology is that orogeny makes continental crust (ŞENGÖR 1990a). This view has developed gradually from older ideas that first equated continent-making with mountain-making and then recognized mountain-making as only a stage in a longer process of continent-making.

2.1 Theories of continental growth until the nineteenth century

Until about the end of the first quarter of the nineteenth century, two main opinions sought to explain the origin and history of our continents. The neptunist view from the Sumerian flood legends (cf. HEIDEL 1949; LAMBERT & MILLARD 1969) to Werner (cf. BINGEL 1934) considered them as original irregularities on the surface of our planet, explaining their growth or destruction as functions of the movements of the hydrosphere, thus taking the "obvious" immobility of the *terra firma* and the high mobility of the waters for granted. By contrast, plutonists from Eratosthenes and Strabo (e.g. STRABO, I, 3.10) to Leopold von Buch (von BUCH 1825, p. 110; 1830, p. 63)[6]) and HOPKINS (1835 and 1847) based their views on the effects of volcanoes and earthquakes and maintained that the present irregularities of the planet's surface were results of deformation generated by vertical (radial) motions that were caused by its "internal fire". The one enduring feature of these early plutonist theories of continent-generation which influenced later ideas was that continent-making and mountain-making were thought to be related processes, both being results of the internal energy of the earth.

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[5]) Continental *growth* here designates only the growth of one particular continent and not necessarily a net gain of continental mass. It is thus used differently from most modern authors (cf. DEWEY & WINDLEY 1981, p. 191). In the sense *growth* is used here, it is equivalent to what DEWEY & WINDLEY (1981, p. 191) call *accretion*. In the penultimate section of this paper we briefly discuss to what extent accretion *à la* DEWEY & WINDLEY may represent net gain of continental mass.

The reason we use *growth* in such a loose sense is because for growth in the sense of net gain in mass to be recognised, a continental crust as distinct from a mantle and/or an oceanic crust had to be distinguished first. This happened during Argand's lifetime and partly through the help of the theory of continental drift. Since a part of this paper deals with the history of ideas, employment of the modern meaning of growth could have led to confusion.

[6]) All page numbers of the publications of Leopold von Buch in this paper refer to those in his *Gesammelte Schriften* edited by Julius Ewald and his collaborators.