CONVECTION CURRENT THEORY [HOLMES] (1)

The process of origin of block mountains, dome mountains & volcanic mountains is more or less well understood. Arthur Holmes postulated his thermal Convection Current theory in the year 1928-29 to explain the intricate problems of the origin of major relief features of the earth surface. Holmes major objectives were not confined to search the mechanism of mountain building based on scientific background but were also directed towards scientific explanation for the origin of continents & ocean basins in terms of Continental drift as he was opposed to the concept of permanency of the Continents & ocean basins as envisaged by the advocates of thermal Contraction of the earth.

Orogenetic force :—

The driving force of mountain building implied by Arthur Holmes is provided by Thermal Convection Current originating deep within the earth. The main source of origin of convection current is "excessive heat in the substratum" wherein disintegration of radioactive elements generates heat regularly.

Base of the Theory :—

According to Holmes, the earth consist of 3 Concentric zones or layers :—

① Upper layer of granodiorite (10-12 km)
② Intermediate Layer (20-25 km) of amphibolite.
③ Lower layer of eclogite.

The origin of convective current within the earth depends on the presence of radioactive element in the rock

The disintigration of radioactive elements generate heat which causes Convective Current. According to Holmes, there is max. concentration of radioactive elements in the crust, but temp. is not so high because there is gradual loss of heat through Conduction & radiation from the upper surface at a rate of 60 Calories/cm² per year. According to Holmes, the loss of heat from the earth surface is compensated by the heat produced by crustal cell of 60 km Thickness. Thus, there is no accumulation of additional heat in the earth crust inspil of max. concentration of radioactive elements.

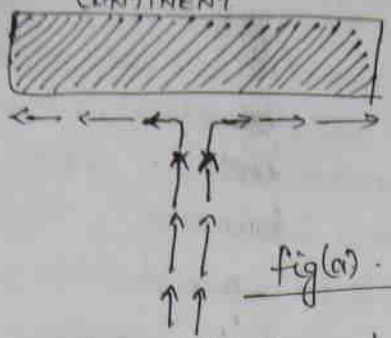
Mechanism of the Theory: —

Convective currents, thus are generated at some places in the substration. Because of difference of temperature gradient from the equator towards the pole rising Convective current are formed under the equitorial crust while downward moving convective currents are generated under the polar crusts. There are 2 situation of convective current when they reach the lower limit of the crustal masses: —

(1) The Crustal mass, where 2 Compressive forces generate causing subsidence in the crustal zones giving birth to geosyncline & closing of sea. The

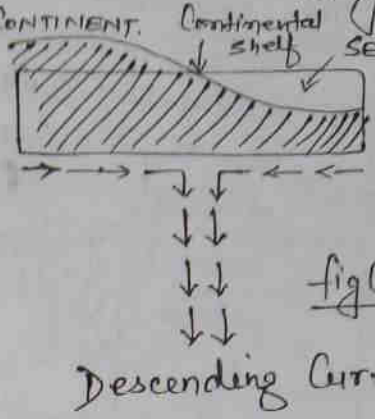
(2) 2 rising convective currents diverge in opposite direction is stretched & thinned due to Tensional forces & ultimately, the crust is ruptured & broken into two blocks which are carried away by lateral divergent convect currents & the opening between 2 blocks becomes sea. Thus divergent Convective Current causes Continental Drift. (fig. b).

(2) Whereas, two lateral convective currents originating under the continental & oceanic crusts Coverage. as given in fig a.



fig(a).

Ascending Current



fig(b).

Descending Current

Compressive force generated which causes subsidence in the crustal zones leading to geosynclines & closing of sea and it is apparent that divergent convective currents move the crustal blocks away in opposite direction & thus creat seas & oceans while Convergent Convective Current bring crustal blocks together and thus form mountains.

According to Holmes, the equitorial Crust was stretched & ruptured due to divergence of rising convective current which carried the Ruptured crustal block towards the north & south and Tethys sea was formed. This phase is called "opening of Tethys". The cyclic pattern of Convective currents & related mountain building passes through 3 phases or stages :—

Stage (1) It is of longest duration during which convective currents are originated in the substratum. The rising convective currents of 2 centres converge under the Continental shelves and thus form Geosynclines due to compression coming from the convergence of 2 shades of lateral current. Geosynclines are subjected

to continuous sedimentation & subsidence. Metamo
of sediments causes rise in their density which in
causes downward movement of the metamorphosed
materials. Thus the falling columns of downward
moving convective current is the column of increasin
density. The first stage characterized by high
velocity convective currents is infact the preparatory
stage of mountain building which is marked
by the creation of geosynclines, sedimentation &
subsidence of materials partly caused by compre-
-ssion resulting from convergence of convective
currents & partly by increase in the density
of materials due to metamorphism.

(2) Stage:- It is marked by phenomenal increase in the velocity of convective currents. But this stage is relatively of short duration. The main cause for the phenomenal increase in the velocity of convective current is the downward movement of cold materials in the falling Column of convective cu & upward movement of hot materials in the rising column of Convective Current. Increased pressure due to metamorphism of geomaterials in the falling Column of descending current increases the velocity of downward moving convective Current. The high velocity convergent convective Con current buckle geosynclinal sediments & thus initiates the process of mountain building. This stage, thus, is called Stage of Orogenesis.

Stage (3) :- It is characterized by waning phase of thermal convective current due to incoming hot materials in the falling Column & upward movement of colder materials in the rising column. Gradually, the rising column becomes cold Column The Termination of mechanism of convective Current comes to an end. It yields several results

i) The materials of falling Column starts rising because of decrease in pressure at the top of the falling Column due to the end of deposition of materials

ii) The depressed & subsided heavier materials in the falling Column of descending convective Currents start rising due to decrease in the weight & pressure at the top of falling Column.

iii) Eclogite, which was depressed downward, gets melted due to immense heat & thus it expands. This stage is known as the "stage of Gliptogenesis".

Evolution of the theory :-

Commenting on Holme's Thermal Convective Current theor
J.A. Steers (1932) has remarked, the theory is interesti
but it depends upon such factor about which, little
is known. It may be pointed out that this comme
of Steers about 68 years ago is not valid today
as there are ample convincing scientific evidences which
validate the mechanism of convective current originatin
within the mantle. The theory was criticized, at
the time of its postulation in 1928-29 on the follow
-ing grounds :-

(1) The whole mechanism of convective current depends on the heat generated by radio active elements in the substratum but several scientist raised doubts abo the availability of required amount of heat generate by radio active elements.

(2) The Horizontal flow of thermal convective current under the continental & Oceanic Crust is also a doubtful phenomena. Because of lack of required amount of heat to drive these currents.

(3) The metamorphism of Amphibolites into eclogites and resultant downward movement of relatively denser eclogite is also a doubtful phenomenon.

(4) According to this theory, convective Currents are originated at few centres only under the continenta and oceanic Crusts, but question arises, why are they not originated at all places ? If this so, happens, the horizontal movement of these currents would not be possible.

— o —