

## Thermohaline Circulation- Its possible consequences upon discontinuation

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**Abstract:** In this paper will be analyze the thermohaline circulation. The factors which determine this water movement are presented and also the factor which conduct at it slowdown. In the end are presented the consequences of the thermohaline circulation slowdown due to global warming.

**Keywords:** Thermohaline transportations, global warming, Coriolis effect, Heinrich event, Eckman transportation.

### I. SEA CURRENTS

In the ocean there is a continuous movement of water, both in surface and in deep, which is slower. Generation and maintenance of these currents involved several interrelated processes: atmosphere and ocean surface sunstroke, winds caused by it, Earth's rotation and the various processes affecting temperature, salinity and density of surface water. Complexity of this global movement is little known by the general public - at least in our country - because environment geography medium education puts little emphasis on studying the oceans and seas, although disruption of this movement can have drastic consequences on the global climate and even long-term future of humanity.

Surface movement. Comprehensive system of movement of the ocean surface is called surface movement.

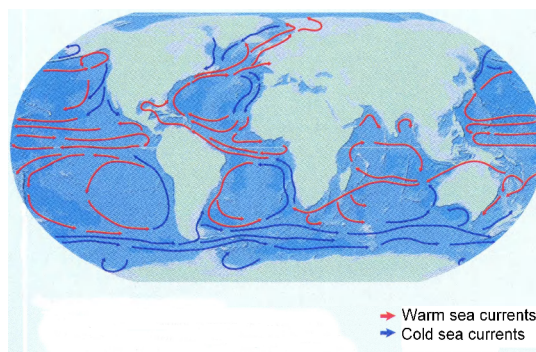


Fig. 1. Surface currents

It is driven by winds, but it is changed by Coriolis effect resulting from the Earth's rotation. Coriolis effect makes the water surface movements imposed by the winds (called friction currents) to drift a bit to the right in northern hemisphere, and left in the southern hemisphere. But due to the emphasis of the Coriolis effect, called Eckman transportation, medium water movement within one hundred meters from the surface is almost perpendicular to the wind movement. The general effect of prevailing winds and Eckman transport on ocean surface is a large circular movements system of water called circular currents, clockwise in the northern hemisphere and vice versa in the southern hemisphere.

Specific components of these currents are circular marginal currents. Marginal currents on the eastern seas are generally weak and cold, and moving toward the equator. Instead, those on the west side are usually strong and warm, and away from the equator.

Eckman transport.

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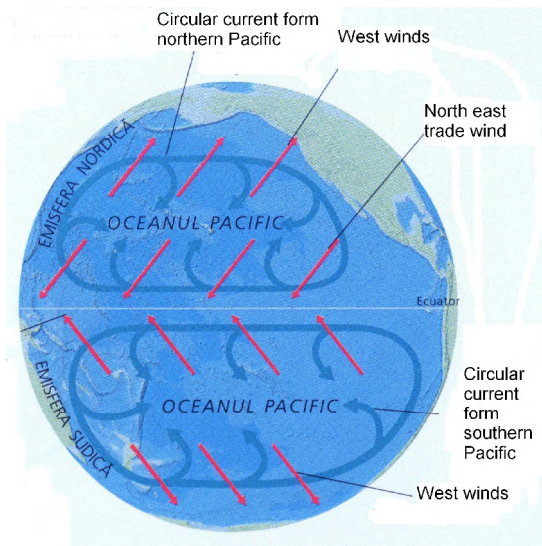


Fig.2. Circular current of Pacific development

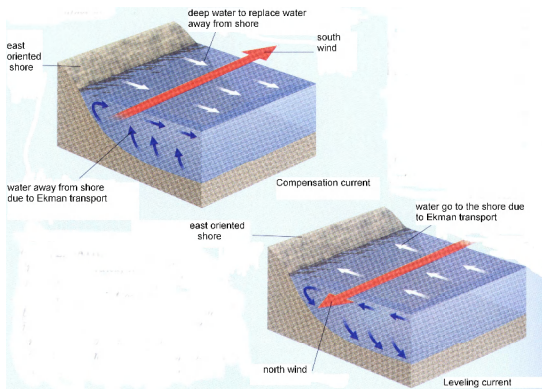


Fig.3. Compensation and leveling coastal currents

At the ocean surface, Coriolis effect diverts less water movement from the friction current direction. This movement produces friction in the layer below which is also diverted, and so on. Deviation from the duplicated layer to layer in depth, so water is pushed average angle of  $90^\circ$  to the wind.

Local currents. Local currents are movements of water caused by tidal forces interact with local coastal forms. Tides causes changes in water levels regularly, most visible are close to shore, and in some places are more pronounced than in others. These vertical changes in water levels can be produced only by horizontal movement of water bodies - for example, to bays and from them. These movements produce local or sea currents, and can be very pronounced when large volumes of water are moved through narrow channels, especially around the promontory, between the islands and estuaries. Since tides are related to, the force and direction of these currents are always changing every hour, according to

daily and monthly tidal cycles. In some areas, they can produce phenomena such as tidal waves and vortices.

Vertical movement.

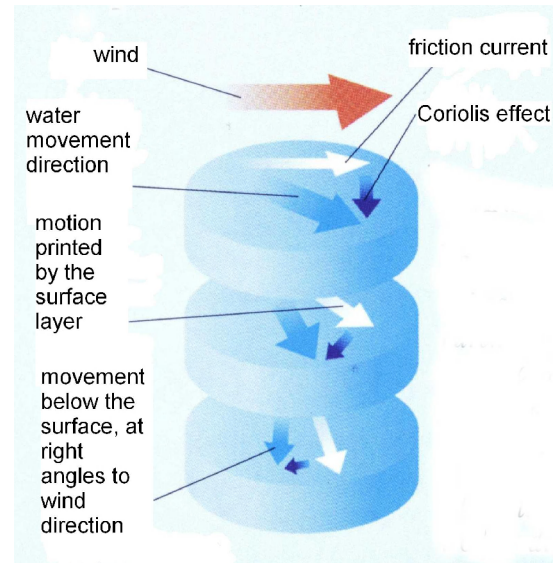


Fig.4. Eckman transport.

Vertical movement refers to movement of water from the surface to depths (smoothing) or vice versa (compensation). One cause is the increasing density of surface water by cooling and / or increased salinity. A great example is the lowering of water under sea ice in Polar Regions. As the water cools, becomes denser and more saline, salt is removed from sea water that freezes, increasing the concentration of water remains unfrozen. Other issue is wind structure, which makes water bodies to gather in a point (which are pushed deep), or to depart (which makes the water rise to replace the displaced water mass). And when the wind blows parallel to the shore, currents may occur or leveling off. Deep waters are rich in nutrients from the decomposition of organic waste which sank from the surface, so their removal from the surface has important biological effects as bringing food to the surface, stimulating plankton growth.

## II. DEEP CURRENTS. THERMOHALINE CIRCULATION (THERMOHALINE TRANSPORTATION)

Deep currents in the world are produced by density differences and changes in water bodies, particularly the sinking of salt water, dense and cold from polar and sub polar areas. When the water reaches a depth and a density, this water is often spread over large distances.

In other parts of the world with lower density water rises to the surface as mix water masses above and absorbs heat from them. This is called the thermohaline circulation (thermohaline) (thermohaline transportations), "thermal" referring to the temperature and the "salt - halina" the salt content. Slow moving deep currents, only a few meters per day. When a volume of water has sunk, it can take hundreds of years to rise again and reverts to the movement of the surface.

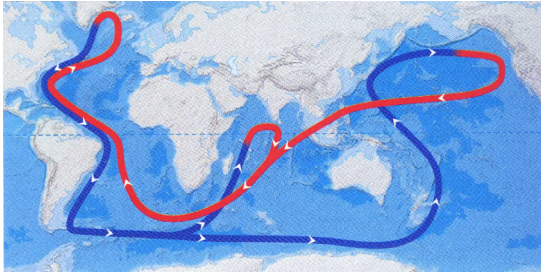


Fig.5.Thermohaline circulation

From basics geography knowledge taught at school, normal school graduate knows the existence of the Gulf Stream - which the manual says that arises in the Gulf of Mexico (hence the name). This current, driven by the Coriolis effect, flows through a loop oriented in northwest North Atlantic passing through Ireland, Scotland northern islands and Norway, warming the climate of these areas, then goes off.

The truth is that this current does not turn on the shores of Norway, but are moving westward again walking across the North Atlantic Arctic spots line up near the southeast coast of Greenland. During this crossing, cool water current, salinity increase their following around Greenland is producing a stream of leveling through dense water masses that sink into the ocean depths. Japanese oceanographers and the Americans have established that the depth at which the diving occurs is around 5000 meters. Water bodies sunk deep cold triggers a current that flows through the whole South Atlantic Ocean, then moving towards the east, crossing the Pacific and Indian oceans, until near the Aleutian Islands.

Walking across the tropical Pacific Ocean, deep water currents mix with x warmer waters from above, warmed gradually, reaching the North Pacific, is born a compensation current and water masses rise to the surface. These masses of water produce the surface warm current which restores the opposite route through the Pacific oceans, Indian and Atlantic to Greenland, where flow resumes.

Along, at the south east of Africa from the mainstream of current depth separate a branch,

this crosses the North-east Indian Ocean; and these branches in turn suffer the same heating process, giving rise to a compensation current, is transformed into a surface loop current path which joins the main stream of the circuit thermohaline return.

Thermohaline heat flow of the circuit is highly influenced by warm currents that are generated by friction due to dominant wind effect in all oceans. Therefore, if the deep cold currents moving very slowly, warm surface currents of thermohaline circuit have the movement speed ten times higher. The engine of thermohaline current is the smoothing circuit from southeast Greenland, the entire circuit is triggered by cold water masses that sink deep into this place. Thermohaline circuit can be interrupted with disastrous consequences if cold water immersion is prohibited by the shutting off leveling current.

A consequence of global warming may be just such a disruption of thermohaline circuit, caused by melting Arctic and Greenland ice caps. With these caps melting in the north will enter huge amounts of fresh water, which dilute the saline water and reducing the salinity of the ocean, and hence the density. As a result, water bodies with low density may not be sinking; leveling current from the south east of Greenland is off, which will cause circuit interruption thermohaline.

Consequences for Europe - especially the west and north - will be a drastic change of climate, including disruption resulting from the Gulf Stream that currently warms those areas. Paradoxically, global warming would lead to the installation of a new ice age at least in Northern and Western Europe, lasting about 2000 years. That period was estimated by Japanese oceanographers; having provided five oceanographic researches took samples of surface and deep water and studied their age by isotope analysis. Following this study concluded that a drop of water falling near Greenland in this circuit will go through the whole journey and will return to place starting in about 2000 years. Japanese researchers have found that the same process thermohaline circuit slowdown is already underway. From measurements result that, although normally the northern Atlantic leveling current should lead to the sinking of cold water at depths of 5,000 meters, the depth was already reduced to about 3000 meters.

The same conclusion on global warming and possible interruption of the thermohaline circuit was obtained by American scientists - Dr. Don Perovich (geophysicist, glaciology), Professor Richard Alley (glaciology), Prof. Leo Kump

(oceanographer, geophysicist), Professor Neil Bogue (oceanographer). Professor Don Perovich even forecast an acceleration of melting Arctic ice cap, given the large difference between the ice albedou, respectively mirror of the seas and oceans. Ice's albedou 80%, while only 20% ocean surface, which means that the oceans actually absorb four times more solar heat than ice mold (which largely reflects sunlight). Therefore, as the more ice melts, less sunlight is reflected and ice melting and ocean warming is accelerating.

Thermohaline circuit interruptions have occurred periodically in the Earth's geological past. When Japanese theory, after the last great glaciations - approximated by those researchers around 13,000 BC - By climate warming, the proof in compliance northeastern U.S. and eastern Canada, has formed a huge freshwater lake, retained by the Atlantic coast and the Alleghany Mountains extending north into Canada, a giant ice barrier about 600 feet high. At one point barrier gave ice, pouring into the ocean freshwater lake. The amount of freshwater discharged was sufficient to produce disruption of thermohaline circulation followed by small glaciations lasting about 2000 years (the length of track thermohaline circuit browser to its restoration, as estimated by Japanese oceanographers).

Professor Leo Kump U.S. states that concluded last ice age 20,000 years ago (still no consensus regarding the timing of geological eras), was followed by a warming about 10,000 years - about 6 ° C warming. Warming has been uneven but periodic interruption due to thermohaline circulation.

In the field of paleontology catch increasing consistency theory that Neanderthal extinction was caused by glaciations caused by the so-called Heinrich events, and not dealing with Homo sapiens. Neanderthal, originating in Africa, migrated into Europe ago 300000-250000 years ago where he lived with 35,000 to 30,000 years, when its extinction occurred. Previous theory is based on the fact that about 40,000 years ago appeared in Europe a new wave of migration, that of Homo sapiens - modern man - also originating from Africa. This theory argues that Homo sapiens was more evolved than Neanderthal man, described as a crude primitive (false, because the Neanderthals had a larger cranial capacity than modern man), because the struggle for survival came to exterminate the population of predecessors.

Under the new theory, be sought in the diet cause extinction of Neanderthal man, who ate meat that

you hunt large mammals, one pet food providing tribe family game for a long time.

Heinrich event, which was repeated several times in the period between 60,000 to 35,000 years ago when there was a gradual extinction of the Neanderthals, regular rate is moving Golf Stream further south- he same case, but more moderate then thermohaline circuit interruption. Heinrich event produced every time micro glaciations in Europe, leading to destruction of vegetation due southward migration of large animals and their gradual extinction, and consequently reduced to extinction of the Neanderthals food sources. Neanderthal was obliged to follow the migration of large animals to southern Europe, migration ended by extinction.

### III. CONCLUSIONS

The conclusion of the above is understood: unless concrete measures are taken, for radical and immediate to slow / stop global warming, it is possible that our grandchildren or great grandchildren to live in climatic conditions quite different from now - a new ice age more or less long.

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