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The Geological Perspective of Climate Change: Ad Memoriam Prof. Claude Allègre

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Abstract: The environmental evidence regarding the present warming of the global climate is very strong, with convincing evidence of human contribution. However, the effect of the dynamic geology and plate tectonics on these variations is often overlooked. Earth global climate is primarily determined by the efficient ability of water to convert solar light into heat and store it. Plate tectonics, describing the shifting geography through geological history, highlights the mobility of the oceans and the continents on the surface of the planet and their impact on climate variability. Since it seems that global warming is a natural phenomenon, mitigating its effects should follow large-scale engineering solutions rather than amelioration of anthropogenic pollution.

Key words: Climate change, Earth-sun orbit, Paleo-oceanography, Ice ages, Milankovitch cycles.

1. Research Review

Already in the 19th Century, naturalists noticed geological evidence of cooler climate periods. Some attributed them to the Biblical flood of Noah, while others, like Louis Agassiz [1], argued for a natural process, but could not be specific. Then James Croll, a janitor from Glasgow University [2], suggested that two cyclic astronomic orbital variations of the Earth's rotation around the sun constrain the glacial events. Croll was promoted from janitor to professor for his explanation of repeated glacial and interglacial events.

Following Croll, the climatologists Wladimir Köppen and Alfred Wegener [3] showed that climate zones migrate towards the poles in warmer geological periods, and towards the equator in colder events. Their collaborator, the astronomer Milutin Milankovitch [4], presented three astronomic parameters affecting climate and causing its variations. Those were the roundness variations of earth's ellipsoidal rotational path around the sun at temporal period of approximately 100,000 years; the tilt of the Earth's rotational axis, which ranges between 20 and 25 degrees at cyclic period of circa 41,000 years; and the earth's rotational precession, with 23,000 years cycles. These variations combine to produce irregular cycles of global cooling and warming by enhancing each other at times and mutually constraining at others.

During most of the earth's geological history, orbital variations had a minor climate effect. However, as continents drifted towards the equator in the last 5 million years, the significance of these variations increased. The convergence of the Australian plate towards Southeast Asia reduced warm seawater flow from the equatorial Pacific Ocean, cooling the Indian Ocean and affecting its monsoon, as Mark Cane and Peter Molnar [5] showed. Then Gerald Haug [6] discussed the closure of the Central American marine passage 2 million years ago, which cooled the Pacific Ocean, and further enhanced the climatic prominence of the orbital variations.

A significant cooling event peaked some 22,000 years ago, when minima of the three Milankovitch orbital parameters probably merged, ice covered large parts of the northern continents while sea-level dropped 125 meters. Sea level, a strong marker of climate

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variations, started to rise when the climate warmed and the ice melted. Cecilia McHugh et al. [7] showed that sea level was 90 meters below the present level some 11,000 years ago, and Rhodes Fairbridge [8] presented evidence that it stabilized 6,000 years ago, with minor fluctuations since. Sea-level changes are global and occur simultaneously in Sidney and New York.

2. Conclusions

Research shows that atmospheric increases of CO_2 and methane, likely anthropogenic, contribute to global warming. However, early Holocene glacier melting and sea-level rise indicate that the effect of orbital variations on the climatic effects cannot be ignored. Claude Allègre [9] argued that despite efforts to reduce global warming damages by decreasing CO_2 and methane emissions, the power of nature suggests that global climate warming will persist further into the Holocene. Consequently large-scale desalination of seawater and upgraded drainage systems are needed to mitigate farmland desertification and urban hurricanes flooding.

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