EARTH'S GRAVITATIONAL DROP MOTIONS

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A detailed analysis of the sea level changes during the Cretaceous (1) revealed a novel (and quite surprising) factor described as "gravitational drop motions" (2). These "drop motions" manifest themselves as geoidal highs and lows that migrate up and down the globe as waves. Prior to the main plate tectonic opening of the Atlantic in the Mid Cretaceous, these waves had a rhythm of about 15 Ma, and after about 100 Ma they have had a rhythm of about 2-4 Ma. The amplitude is several tens to some hundreds of meters sea level differences (3, 4).

The name "drop motions" was given because of the physical analogy with real drop motions with the elasticity of a drop substituted by the gravity of the Earth.

Gravitational drop motions are believed to be linked to fundamental geophysical processes (1-4). It is likely that we in the future will be able to identify a spectrum of drop motions of different wave-length and of different geographical orientation (cf. 1). Its most instantaneous example may be the well-known "free oscillations" of the Earth.

Gravitational drop motions have now been identified also during the late Cenozoic (2-4), and they seem even to be responsible for the main geoid deformation during the last 8000 years (with expantion in the northern hemisphere and contraction in the southern hemisphere; 2-4). At around 3.1 Ma, there was a rapid change in sea level over most of the globe; a regression from high to low level (e.g. in Panama, the Mediterranean) or a transgression from low to high level (e.g. in SE Australia, Chile, Bering Strait). This lead to drastic paleoceanographic changes (5); the Balboa Strait was closed and the Gulf Stream came into being, the Bering Strait was opened and a cross-polar flow was initiated (bringing Pacific molluscs to Iceland), the sea temperature rose in the North Sea and the Mediterranean climate as we know it today was established.

With gravitational drop motions, like any other form of geoid deformation, the "Exxon Eustatatic Curve" (6, 7) cannot represent synchronous and global sea level changes (2, 4, 8). The rates and amplitudes of the regressions are simply physically impossible to explain in terms of global eustasy, only in terms of non-synchronous geoidal eustatic changes (geoid deformations) that must differ in amplitude and sign over the globe (4, 8).

The gravitational drop motions represent a novel factor in Earth's geophysics. These motions are linked to so fundamental processes and problems that they by all means deserve to be accepted, if not in theory, at least as a matter for further investigation.

References

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