

Discorditarianism: A New Paradigm for Geological Interpretation

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INTRODUCTION

The fundamental geological paradigm of uniformitarianism played a foundational role in establishing geology as a modern science (Gould, 1965; Alvarez, 1989), though today, it is reductively defined as “the present is the key to the past” (Romano, 2015). Early interpretation of Earth’s evolution centered around catastrophism, which posited that sudden extreme events, such as floods, could erase species and form thick layers of rock and fossils within a timeline consistent with biblical understanding. As knowledge of Earth grew, and its great age became apparent, gradualism developed, from roots such as Comte de Buffon’s early observations, recognizing that many rocks on Earth likely accumulated slowly and steadily, so allowing for inference of rates and processes between the present and the past (Buffon, 1778; Rudwick, 2014). William Whewell coined the term uniformitarianism in 1832 as an opposite to catastrophism, such that geological discussion became the Uniformitarians versus the Catastrophists (Whewell, 1832). Over time, catastrophism became realigned with modern understandings of Earth that diverged from biblical studies, to become neocatastrophism, which remains an important element of modern event stratigraphy.

Uniformitarianism has been revisited and revised many times (e.g., Gould, 1965; Rudwick, 1972; Mayr, 2011), with the aim of clarifying its definition, though this has arguably led to today’s “semantic chaos” (Dresow, 2023). Through such discussions, uniformitarianism has developed a new meaning beyond the principles of gradualism and has essentially become a law of simplicity based on Charles Lyell’s entire theoretical system (Rudwick, 1972; Alvarez et al., 1989). As such, all events, be they rapid or gradual, could be encompassed within the modern principle of uniformitarianism (Romano, 2015), based on three factors:

1. Process continuity: The same types of processes have always occurred and in the same manner.
2. Rate consistency: Processes have occurred at generally comparable rates over geological time, similar in principle to gradualism.
3. Uniformity of physical laws (essentially coincident with actualism): Actualism dictates that the same physical laws apply across all of Earth’s history.

Nevertheless, there are significant cases where no direct analogues exist, such as Earth’s accretion or the emplacement of large igneous provinces, so non-uniformitarianism is invoked when we rely on geological inference for interpretation (Dresow, 2023). However, this Earth-centric perspective overlooks some contemporary extraterrestrial observations, like the atmospheric cycle on Titan and fluvial meanders on Mars, which obey elements of uniformitarianism in non-Earth settings. As such, some of these “non-uniform” processes may have universally uniform elements, and analogues for interpreting Earth may just be constrained by our immediate observational bias.

LIMITATIONS OF UNIFORMITARIANISM

The Lyellian view of uniform rates, processes, and laws (i.e., “substantive uniformitarianism”) is often incorrect and can be misleading (Gould, 1965; Alvarez, 1989; Alley, 2001; Dresow, 2023). Actualism persists in the currents of a river, and gravity, yet many Earth processes lead to complex systems displaying nonlinearity, time lags, and feedback loops, in which uniformitarianism can be difficult to apply. “Methodological uniformitarianism,” through which present-day understanding is applied to the past or future, remains vital for advancing scientific understanding and for hypothesis generation (Gould, 1965; Dresow, 2023), though it is still inadequate for brief, transformational events (Alvarez, 1989).

Where systems are said to “not obey uniformitarianism,” this is an exclusion, not an analytical framework. Such exclusion from uniformitarianism is increasing due to novel kinds of Earth surface processes associated with human-driven geological change, and so a philosophical forum is needed to properly consider a difference that is not simply exclusionary. Uniformitarianism’s lack of epistemological space for difference is central to its limitations for geological reasoning, which have affected geology via a resistance to accept changes and catastrophes in the geological past due to a general oversimplification of Earth’s history (Alvarez, 1989), and may have delayed the study of the origins and early evolution of Earth (Alley, 2001).

Today’s challenge is that we live amongst a higher degree of landscape complexity than has ever existed in geological time, such that a “law of simplicity” is difficult to uphold.

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Human-altered landscapes are not wholly driven by physical laws, but include sociopolitical and economic drivers, which means that, crucially, the cause-and-effect relationships underpinning our understanding of the environment are, to varying degrees, decoupled from geohistorical baselines and entangled with human agency. This is critical because if we cannot meaningfully understand cause-and-effect relationships, we cannot make testable hypotheses, and therefore we cannot do inductive science.

INTRODUCING DISCORDITARIANISM

We introduce the paradigm of discorditarianism to crystallize the conceptual space that presents an objective bridge between process-based earth system science and evidence-based stratigraphy, such that we may more methodologically analyze uniformity and discordance in geological history. Discorditarianism is a complementary, not competing, paradigm to uniformitarianism. The term “discorditarianism” offers epistemic traction and adds a structured way to identify, define, and, ideally, quantify geological discordance.

Discorditarianism expands the potential for geological science to incorporate “human impact” without oversimplistically collapsing it into a homogeneous force; however, it is importantly not human-centric and may be applied to any change or difference in geological history. For example, transformation of geomorphological patterns may be due to the emergence of forests (Gibling et al., 2014) or the inception of plate tectonics (Palin et al., 2020), as well as various changes to physio-chemical conditions, including climate and the biosphere.

The paradigm of discorditarianism allows for a long-needed methodological consistency in forming structured descriptions of complex phenomena formed by geological processes that range from uniformity to discordance. It aids in finding opportunities to apply existing knowledge, to identify knowledge gaps, and to develop interdisciplinary collaborations. The methodology is:

1. Determine exactly what is being compared. Consider what temporal scales or specific time horizons, landscapes, or objects are being compared and why.
2. Identify which elements of uniformitarianism apply. Consider similarities in process, rate, flux, event frequency, physical laws, or broader consistencies and their extent.
3. Describe the spatial character of the discordance. Consider its scale, patterns, and its lateral and vertical extent (e.g., local, regional, or global).
4. Describe the temporal character of the discordance. Consider its longevity frequency, and any changes in intensity, distribution, or impact over time.
5. Outline the forces that led to, and are impacted by, the discordance, and identify which have increased or decreased. Consider *all* forces, from a newly appeared plant species changing soil stability to a new law or socioeconomic policy that has affected landscape engineering.

Consider, say, a river downstream of a dam before and 10 years after a dam installation intended to stabilize the water supply for surrounding farmland. Locally, the river will reflect processes driven by the physical laws consistent with uniformitarianism. At a regional scale, the dam emplacement was a geologically rapid event, with prolonged impact on the river's discharge, sediment supply, composition, and much more. As such, the river reach is clearly discordant to its geological past as a range of socioeconomic forces led to physical changes that now impact the river's natural progression toward landscape equilibrium.

The paradigm of discorditarianism provides a structured method to evaluate the extent to which, and nature with which, Earth's deposits reflect uniformity (simplicity) and discordance (complexity) within Earth's systems, including evaluating the extent to which the present is not the key to the past.

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