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# Re-situating fieldwork and re-narrating disciplinary history in global mega-geomorphology☆

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A B S T R A C T

In 1985, more than thirty geomorphologists, planetary scientists, and remote sensing specialists gathered at a conference center in Oracle, Arizona, to discuss an emerging area of research that they called "mega-geomorphology." Building on a conference of the same name held in London in 1981, they argued that new techniques of remote sensing and insights emerging from the study of extraterrestrial planets had created opportunities for geomorphology to broaden its spatial and temporal scope. This new approach was, however, neither unproblematic nor uncontested. In the discussions around mega-geomorphology that took place in the mid-1980s, the perceived conflict between the use of remote-sensing techniques to observe phenomena on vast spatial scales, on one hand, and the disciplinary centrality of fieldwork and field experience to geomorphology, on the other, was a recurrent theme. In response, mega-geomorphologists attempted to re-situate fieldwork and re-narrate disciplinary histories in such a way as to make remote sensing and planetary science not only compatible with geomorphological traditions but also means of revitalizing them. Only partially successful, these attempts reveal that the process of adopting a planetary perspective in geomorphology, as in other earth sciences, was neither straightforward nor inevitable. They also show how the field and fieldwork could remain central to geomorphology while also being extensively revised in light of new technical possibilities and theoretical frameworks.



On a clear, cool day in January 1985, a group of geomorphologists set out from the Sunspace Ranch Conference Center in Oracle, Arizona, on a field trip led by Victor R. Baker of the University of Arizona (Ely & Baker, 1985). Beginning at the northwestern end of the Santa Catalina Mountains, they worked their way south along Highways 77 and 89 to Interstate 10, which brought them to Tucson, where they continued south along Interstate 19 to the Santa Rita Mountains. Along the way, they stopped to observe notable features of the landscape, including a "sequence of terraces, pediments, and fans in the Cañada del Oro drainage," a "series of pediments and alluvial fans flanking the Tucson Mountains," the "effects of a recent, large flood on the Santa Cruz River," and "[a]lluvial fan surfaces and Pleistocene faulting in the Madera Canyon area of the Santa Rita Mountains." At each site, they attempted to characterize the surface of the land in terms of "age, genesis, soils, lithology, and vegetative cover" and discussed the role of climatic factors and plate tectonics in shaping it (Baker, 1985a, p. 121). Experiencing the landscape in person and observing it with their own eyes, they speculated on the deep histories that had resulted in its present-day large-scale features.

Even as they were examining and discussing these geomorphological features from the perspective of the field, however, they also had another view in mind — that provided by space-based remote sensing. The field trip came at the end of a three-day workshop on the theme of Global Mega-Geomorphology that was co-sponsored by the National Aeronautics and Space Administration (NASA) and the International Union of Geological Sciences. The aim of the workshop was to explore the use of Landsat and other sources of remote-sensing imagery to understand very-large-scale landscape features on Earth and other planets. At its foundation was the premise that space-age technologies made it possible to view the Earth in radically new ways. As Robert S. Hayden of George Mason University put it in his introduction to the conference proceedings published later that year, "[w]ith the advent of manned orbital and space flight and of satellites capable of recording and transmitting pictorial information about the Earth from several

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hundred or more miles above the surface, it has become possible, for the first time, to observe directly large regions of the Earth's surface and to perceive the Earth as a whole from space" (Hayden, 1985a, p. 1).

Such themes were novel to geomorphology at this time, but they were becoming increasingly common throughout the earth sciences as they adopted a "planetary imagination" of the Earth (Messeri, 2016, p. 5). During the 1970s and 1980s, photographic images of the Earth from space became widely available and were linked to environmental concerns (Grevsmühl, 2016; Helmreich, 2011; Jasanoff, 2001; Lazier, 2011; Maher, 2004; Poole, 2010) and scientists developed a number of new ways of understanding the planet as a single integrated system, from the Gaia hypothesis to Earth Systems Science (Dutreuil, 2014; Ruse, 2013; Uhrqvist, 2015). For geomorphologists, these developments generated both challenges and opportunities. Even as other earth sciences had increasingly turned toward models, simulations, experiments, and remote sensing as the foundation of their claims about nature (Oreskes & Doel, 2003), geomorphologists continued to ground their disciplinary identity and epistemic authority in personal observations of landforms and land-forming processes in particular places. Geomorphology, they believed, was fundamentally a field science (Church, 2013; see; Kohler & Vetter, 2016). The idea that they could now "directly" observe and perceive large regions of the Earth, or even the Earth as a whole, without leaving their offices was therefore a controversial one that provoked vigorous debates in the 1980s.

The discussions around mega-geomorphology as a new method and subject of investigation for geomorphology in the 1980s show how this discipline within the earth sciences responded to the possibilities and challenges posed by instrument-based observation, remote sensing, whole-Earth views, and planetary imaginations (Helmreich, 2009; Vetter, 2011; Grevsmühl, 2014; Höhler, 2015; Camprubí, 2016; Messeri, 2016, 2017). Among other things, they suggest that the adoption of such technologies and perspectives was neither easy, uncontested, nor inevitable. The process of assimilating methods of observation that distanced the observer from the phenomena in question and interjected new forms of mediation into the practices of geomorphologists was partial and incremental. It involved both the development of new techniques and attempts to narrate those techniques as continuous with the disciplinary traditions of geomorphology. It is in this light that the field trip at the end of the Global Mega-Geomorphology workshop in 1985 should be seen — that is, as an attempt to reconcile geomorphologists' training and traditions as field scientists with the new possibilities and perspectives opened up by space-age technologies. As the subsequent history of mega-geomorphology shows, this reconciliation was only partially successful in the 1980s, and it remained a challenge in the following decades. Directly experiencing global phenomena was not impossible, but it was also not easy.

## 1. Inventing mega-geomorphology

The term "mega-geomorphology" did not have a long history or prominent role within geomorphology before the 1980s. Indeed, the earliest use of the term I have been able to find dates to 1978, when it was mentioned in passing in a paper on the "Significance and Origin of Big Rivers" by the University of Cincinnati geologist Paul Edwin Potter (Potter, 1978, p. 25). The first significant use of the term came in 1981, when it was chosen as the title of an international conference in London organized by the British Geomorphology Research Group, which brought together researchers from United Kingdom, the United States, Australia, Canada, France, Poland, and Sweden. Two years later the conference proceedings were published under the title *Mega-Geomorphology* (Gardner & Scoging, 1983). In her introduction to the volume, Rita Gardner of King's College London explained that she and the conference's other organizers had used the term to refer to "mega-scale" studies that addressed phenomena of "large spatial extent, varying from regional to continental scales" (Gardner, 1983, p. x). Emphasizing studies of large areas had become necessary, she argued, because geomorphology had increasingly narrowed its focus to small-scale processes that could be studied experimentally or in the field using quantitative measurements and mathematical methods. It had thereby lost sight of important topics that could only be addressed on larger spatial and temporal scales. At the 1985 London meeting, "mega-geomorphology" was thus positioned as corrective to a field that had lost its balance in pursuit of mathematical and experimental rigor.

The response of the broader geographical community to this proposal was mixed, at least judging by published reviews of the conference proceedings. In the *Geographical Journal*, for example, J.A. Steers noted with approval the volume's interest in reviving studies of large areas but questioned whether "mega" was the right term to describe them, especially since not all of the volume's contributions focused on large areas (Steers, 1984, p. 385). Moreover, the absence of any multi-authored expedition reports from the volume also struck him as unfortunate, since "to know well a very large (a 'mega') area takes a very long time," as well as, usually, a multi-disciplinary team (Steers, 1984, p. 384). In the *Geographical Review*, William L. Graf wrote that the collection had "unquestioned intellectual value" (Graf, 1984, p. 367) but also noted that the individual chapters did not always fulfill the integrative promise of the volume's title. One of the strongest chapters gave "only sparse attention to geomorphology" (p. 365), while one of the most valuable geomorphological contributions did "not consider very large-scale features as do the other authors" (p. 366). Alan V. Jopling offered perhaps the most positive assessment in a review for *The Professional Geographer*, describing the volume as inconsistent but engaging. "The use of the prefix 'mega' in the title is perhaps a bit gimmicky," he wrote, "but who cares, it's a neat little volume that presents a global viewpoint and captures the reader's attention" (Jopling, 1985, p. 234). On the whole, reviewers seem to have found *Mega-Geomorphology*'s big-picture ambitions admirable but unevenly executed, while the term itself seemed at best gimmicky and at worst misleading.

If they were aware of these criticisms, the co-organizers of the workshop on Global Mega-Geomorphology in Oracle in 1985 — Victor R. Baker of the University of Arizona, James W. Head III of Brown University, and Nicholas M. Short of NASA's Goddard Space Flight Center — did not let them stop them from appropriating the term for their own purposes. The initial impetus for the Oracle workshop came from Short, who had been working on an atlas of images acquired from space that were relevant to the study of geomorphology. A follow-up to the highly successful *Mission to Earth: Landsat Views the World* (Short, Lowman, Freden, & Finch, 1976), the new volume was meant to differ in its focus on the science of landforms. As the volume neared completion Mark Settle of NASA's Earth Observations Program encouraged Short to organize a workshop around its themes (Short & Blair, 1986a, p. xvi). Short then reached out to Baker, whose work in paleohydrology had led him to study mega-floods on both Earth and Mars (e.g., Baker, 1978), and Head, a geologist who had been involved in the scientific training of astronauts for the Apollo program and studies of volcanism on the Moon and extraterrestrial planets (e.g., Head & McCord, 1978). Short himself was a geologist and geochemist who had begun his career analyzing the effects of nuclear explosions for Project Plowshare (Kaufman, 2013; Kirsch, 2005; Short, 1970a; see) and later studied the formation of impact craters on

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