

## Late Pleistocene and Holocene dune activity and wind regimes in the western Sahara Desert of Mauritania: Comment and Reply

### COMMENT

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Lancaster et al. (2002) provide some useful information on Quaternary eolian dune activity in western Mauritania. As outlined below, however, their publication could benefit from (1) a statement regarding the relevance of their research to the debate on the age of "Ogolien" dunes in western Mauritania, (2) a different interpretation of the timing and duration of episodes of Quaternary eolian dune activity in western Mauritania, and (3) an acknowledgment of previous work by certain French geologists.

The most significant aspect of the publication by Lancaster et al. (2002) is the dating of the dunes, particularly the "Ogolien" dunes. In the French literature, the term "Ogolien" is used to denote a period of eolian dune construction that is thought to have occurred ca. 20,000–13,000 <sup>14</sup>C yr B.P. (ca. 24,000–15,400 cal. yr B.P.) in the Mauritania/Senegal region (e.g., Beaudet et al., 1976; Elouard, 1976; Michel, 1980; Barbey, 1989). The dates provided by Lancaster et al. (2002) are the first dates obtained from these Ogolien dunes, but Lancaster et al. fail to point out the originality and significance of this work. Assuming different ages of these dunes leads to very different interpretations, especially regarding the sequence stratigraphy of eolian sediments (i.e., when are eolian sediments active and/or preserved in the stratigraphic record, relative to sea-level changes and glaciations?). Prior to the publication of Lancaster et al. (2002), the most accurate statement that one could make concerning the age of Ogolien dunes in the coastal region of western Mauritania was that the Ogolien dune sands at Site M8 (described in Barousseau et al., 1989; Swezey, 2001) are older than the oldest dated marine shells (ca. 7100 cal. yr B.P.) at that site. The new data published by Lancaster et al. (2002) suggest that Ogolien dunes in western Mauritania range in age from ca. 27,000 to 8,000 cal. yr B.P., and that Ogolien dune activity in western Mauritania spanned this entire range of ages.

Although Lancaster et al. (2002) report numerous dates from the dunes in western Mauritania, they may have misinterpreted their data in an attempt to correlate their dates with other dates from the rest of the Sahara. Lancaster et al. (2002) claim that their dates indicate that separate episodes of eolian dune activity occurred in western Mauritania at 25–15 ka, 13–10 ka, and <5 ka. However, when one considers ranges of uncertainty, the dates reported from the eolian dunes do not fall into three separate groups. Some of the ranges of uncertainty of the dates span the range between the 25–15 ka group and the 13–10 ka group proposed by Lancaster et al. (2002). Although there is evidence in other parts of the Sahara for multiple episodes of late Quaternary eolian activity (Swezey, 2001), three separate episodes of late Quaternary eolian dune activity cannot be recognized in western Mauritania on the basis of the dates that are currently available.

Finally, Lancaster et al. (2002) do not give appropriate credit to work published previously by various French geologists. For example,

Lancaster et al. (2002) describe three different dune trends in western Mauritania (degraded dunes with a northeast trend, degraded dunes with a north-northeast trend, and nondegraded dunes with a north trend). These three dune trends have been identified and described in some detail by Hébrard (see Bureau de Recherches Géologiques et Minières, 1975; Hébrard et al., 1983), who postulated that the northeast-trending dunes were older than 30,000 <sup>14</sup>C yr B.P., the north-northeast-trending dunes were ca. 20,000 <sup>14</sup>C yr old, and the north-trending dunes were of recent age. Likewise, Lancaster et al. (2002) indicate that Kocurek et al. (1991) "identified a glacial-age period of dune construction (called the Ogolien in Mauritania)." Although it is true that Kocurek et al. (1991) published information on these dunes, it would be more appropriate to credit the identification of this period of dune construction to the original work by Elouard (1962, 1976), Beaudet et al. (1976), Michel (1980), and Hébrard et al. (1983).

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## REPLY

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We appreciate Swezey's interest in our paper, but we have to disagree with his reinterpretation of our data.

Swezey's statement that our data suggest that "Ogolien" dunes of western Mauritania range in age from 27–8 ka is apparently based upon the total range of all of the optically stimulated luminescence (OSL) dates and their errors. The error bars in fact reflect the precision of individual OSL dates, and it is erroneous to assume that eolian activity spanned this entire period. OSL dates are also but one type of data and, like any other chronometric data, need to be placed within a stratigraphic/geomorphic context. Most significant here is that the dunes occur in three different sizes, which are organized into three distinct trends that reflect three different wind regimes. We interpret these trends as the result of three episodes of eolian activity, and argue that their geomorphic expression is important in understanding how dune fields respond to constructional events separated in time. This interpretation is further supported by the OSL ages, which, when analyzed statistically, fall into distinct clusters on a probability density curve.

Our OSL dates in the 25–15 ka range are from the large, northeast-trending linear dunes. These dates suggest that this dune trend, which is the one locally termed Ogolien, corresponds to the eolian constructional event of the Last Glacial Maximum (e.g., Sarnthein, 1978). OSL dates clustering between 10 and 13 ka occur within

the much smaller, north-northeast-trending linear dunes. A significant result of our study is that the Younger Dryas event (12.5–11.5 ka) may be manifested in the region by this second dune trend. There is little data on the environmental conditions between the Last Glacial Maximum and the Younger Dryas in the region, but the two trends of linear dunes clearly reflect separate generations of eolian construction, and there is no geomorphic and stratigraphic evidence that supports the second dune trend as a continuation of the Ogolien episode.

The termination of the second eolian constructional event and the manifestation of the African Humid Period in the region are well documented by interdune lacustrine deposits that overlie eolian strata and onlap the relict dunes. The relict dunes additionally show a paleosol zone indicating stabilization. The oldest lacustrine deposit in the area that we know of is our sample of organic material (TX-7182) that is  $^{14}\text{C}$  dated at  $9410 \pm 150$  yr B.P. (ca. 10.5 ka), and which is included in the review by Swezey (2001). This predates the ca. 7.1 ka age from Barusseau et al. (1989) given by Swezey in his discussion of the onset of humid conditions (i.e., termination of the Ogolien event) in the Mauritanian coastal region. The third (and present) episode of eolian activity in the area began ca. 5 ka, in agreement with  $^{14}\text{C}$  dates for the cessation of lacustrine deposits (e.g., Kocurek et al., 1991; Swezey, 2001).

References to the dunes and interdune lacustrine deposits of the region are indeed extensive, especially by our French colleagues, but unfortunately restrictions on the length of papers in *Geology* preclude any extensive discussion of previous work. Kocurek et al. (1991) provide the reader with a detailed discussion of previous work, including those (and others) noted by Swezey. Similarly, we used the review paper by Swezey (2001) as a vehicle to address and refer to the regional data, and could not cite the extensive battery of works that the Swezey paper summarizes.

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