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Paleohydrology of China Lake basin and the context of early human occupation in the northwestern Mojave Desert, USA

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ABSTRACT

Considerable prior research has focused on the interconnected pluvial basins of Owens Lake and Searles Lake, resulting in a long record of paleohydrological change in the lower Owens River system. However, the published record is poorly resolved or contradictory for the period encompassing the terminal Pleistocene (22,000 to 11,600 cal BP) and early Holocene (11,600–8200 cal BP). This has resulted in conflicting interpretations about the timing of lacustrine high stands within the intermediate basin of China Lake, which harbors one of the most extensive records of early human occupation in the western Great Basin and California. Here, we report a broad range of radiocarbon-dated paleoenvironmental evidence, including lacustrine deposits and shoreline features, tufa outcrops, and mollusk, ostracode, and fish bone assemblages, as well as spring and other groundwater-related deposits (a.k.a. "black mats") from throughout China Lake basin, its outlet, and inflow drainages. Based on 98 radiocarbon dates, we develop independent evidence for five significant lake-level oscillations between 18,000 and 13,000 cal BP, and document the persistence of groundwater-fed wetlands from the beginning of the Younger Dryas through the early Holocene (12,900–8200 cal BP); including the transition from ground-water fed lake to freshwater marsh between about 13,000 and 12,600 cal BP. Results of this study support and refine existing evidence that shows rapid, high-amplitude oscillations in the water balance of the Owens River system during the terminal Pleistocene, and suggest widespread human use of China Lake basin began during the Younger Dryas.

1. Introduction

The Owens River system once drained almost the entire eastern Sierra Nevada, from Mono Lake to Owens Lake, and extended well into the northern Mojave Desert, through Indian Wells Valley and China Lake basin, Searles and Panamint valleys, finally ending at Lake Manly in Death Valley (Fig. 1; Gale, 1914, 1915; Smith and Street-Perrott, 1983). During the terminal Pleistocene (22,000–11,600 cal BP), however, the paleo-Owens River only connected the intermediate basins of Owens, China, Searles, and Panamint lakes (Benson et al., 1990; Jayko et al., 2008; Smith, 2009; Smith and Street-Perrott, 1983); by the early Holocene (beginning 11,600 cal BP), the river terminated at Owens Lake (Bacon et al., 2006; Smith, 2009:Figure 39, 81–82). Numerous important studies document the fluvial history of the lower Owens River system and have contributed significantly to regional paleohydrological models and evidence for long-term climate change in the southwestern United States (Bacon et al., 2006; Benson, 2004; Benson et al., 1990, 1996, 1997, 1998, 2002; Bischoff et al., 1985; Dorn et al., 1990; Flint and Gale, 1958; Garcia et al., 1993; Jayko et al., 2008; Lin et al., 1998; Orme and Orme, 1993, 2000, 2008; Phillips, 2008; Phillips et al., 1996; Reheis et al., 2014; Smith, 1963, 1968, 1979, 1987, 2009; Smith and Bischoff, 1997; Smith and Street-Perrott, 1983; Stuiver, 1964).

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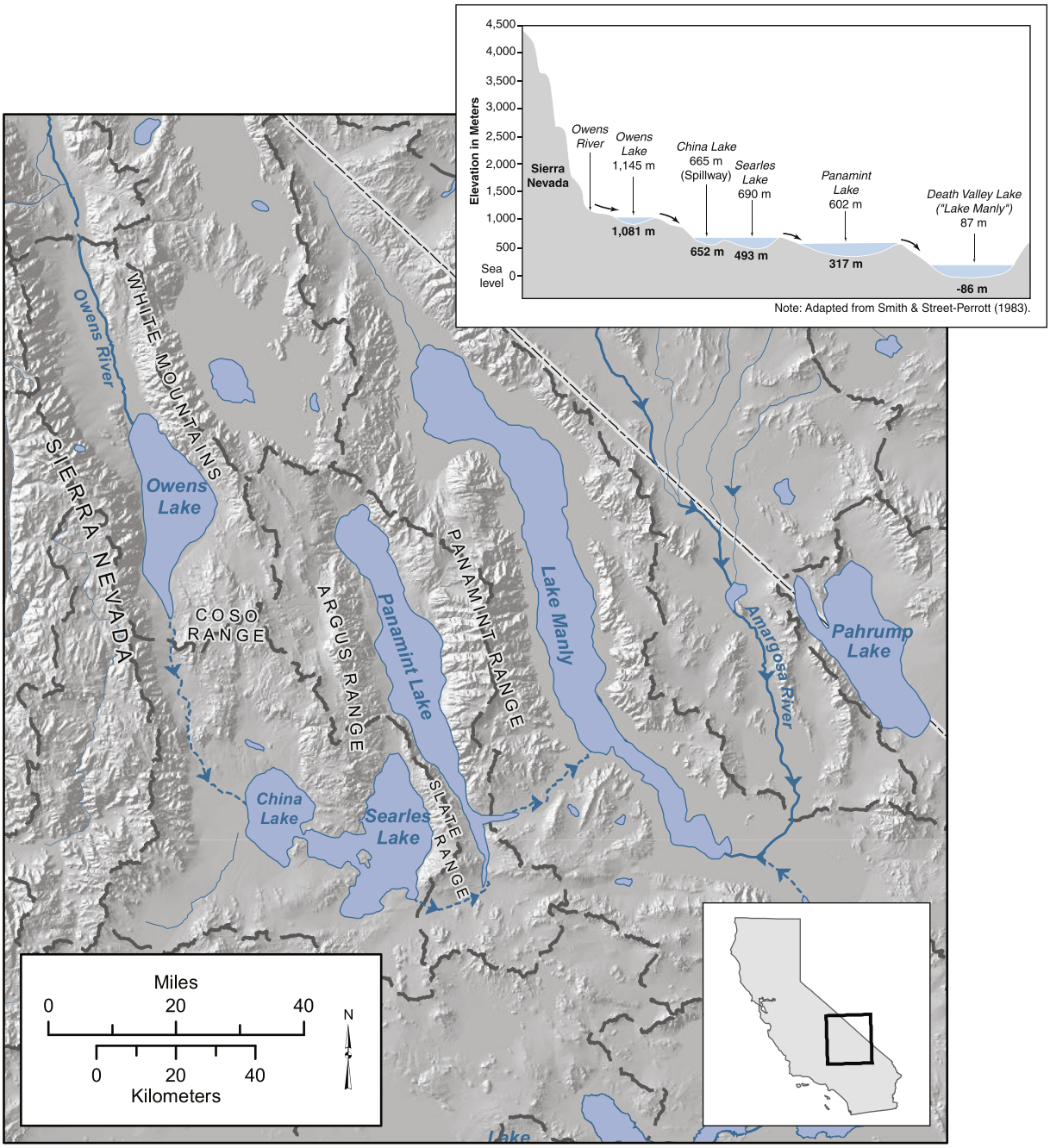

Fig. 1. Hydrologically connected pluvial lake basins in the lower Owens River system.

Despite good evidence for the timing of major lake oscillations in the interconnected basins of the Owens River system, there is poor resolution or conflicting information for the period encompassing the terminal Pleistocene and early Holocene (ca. 22,000–8200 cal BP; c.f., Bacon et al., 2006, 2014; Benson et al., 1990, 1996, 1998; Orme and Orme, 2008; Smith, 2009; Smith et al., 1997). Since overflow from Owens Lake through the lower Owens River would be required to fill Searles Lake and all other downstream basins (Smith, 2009:81–82; Smith and Street-Perrott, 1983:199), the intermediate China Lake basin is well-situated to resolve inconsistencies between the upstream and downstream hydrological records. Likewise, the comparatively shallow depth of China Lake basin (about 13 m), suggests that lake levels would have responded much more quickly to changes in the regional hydrological balance than the much deeper downstream basins of Searles and Panamint (Smith and Street-Perrott, 1983:Table 10.2).

China Lake basin is also one of very few places in the Mojave Desert that manifests substantial evidence for human occupation during the terminal Pleistocene and early Holocene, with no fewer than 100 surface sites producing diagnostic tools or early obsidian hydration readings characteristic of this time period (Basgall, 2004, 2007; Byrd, 2006, 2007; Davis and Panlaqui, 1978; Giambastiani