

Comparison of fire and vegetation dynamics depending on human impact in the Orkhon Valley during the Late Holocene

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Purpose of the study

Mongolia presents a great variety of landscape and climate, depending on the altitude which differs between the boreal forests of mountainous regions of the Altai in the Northwest and the steppe regions of Central Mongolia. The vegetation and fire dynamics have been impacted by both climate and human activities, which have been present there since the Upper Palaeolithic (46000 - 12000 cal. yr BP) mainly as small groups of hunter-gatherers (Tumen 2006). Since the Early Middle Bronze Age (4450 cal. yr BP) pastoralism has strongly developed (de Barros Damgaard *et al.*, 2018; Jeong *et al.*, 2018; Tumen 2006). The Orkhon Valley region in the Central part of Mongolia (Fig. 1) is not well documented in terms of Holocene paleo-ecology and yet it is a region of interest since there was a major place of life and economy, Karakorum, an ancient Mongolian capital from 690 to 720 cal. yr BP (1230 to 1260 AD). Here, we present a comparison of pollen analysis and fire activity between 2 sites of the Orkhon Valley : DB (Deliin Burd lake) site, about 35 km far from Karakorum and SNN19 (Shireet Naiman Nuur lake, (Bliedtner *et al.* 2022)), about 100 km far from Karakorum.

Material & methods

DB core (47°01'37.50"N, 103°13'18.10"E) was extracted in 2016 and SNN19 core (46°31'58.56"N, 101°49'13.26"E) has been cored in 2019 (Fig. 1). For both cores, age-depth model were developed using the 'Bacon' v2.2 R package (IntCal13 and NH1 calibration). To reconstruct Holocene past fire history, macro-charcoal particles found in the sediment cores DB and SNN19 were counting and measuring with WinSeedle® software (Oris *et al.*, 2014) and analysed with CHAR® (CHAR, Blarquez *et al.*, 2015). This analysis distinguish the peaks of charcoals and therefore fire events. Palynological studies was performed after Faegri and Iversen (1989) and pollen grains and NPP were identified and counted (minimum 300 pollen grains).

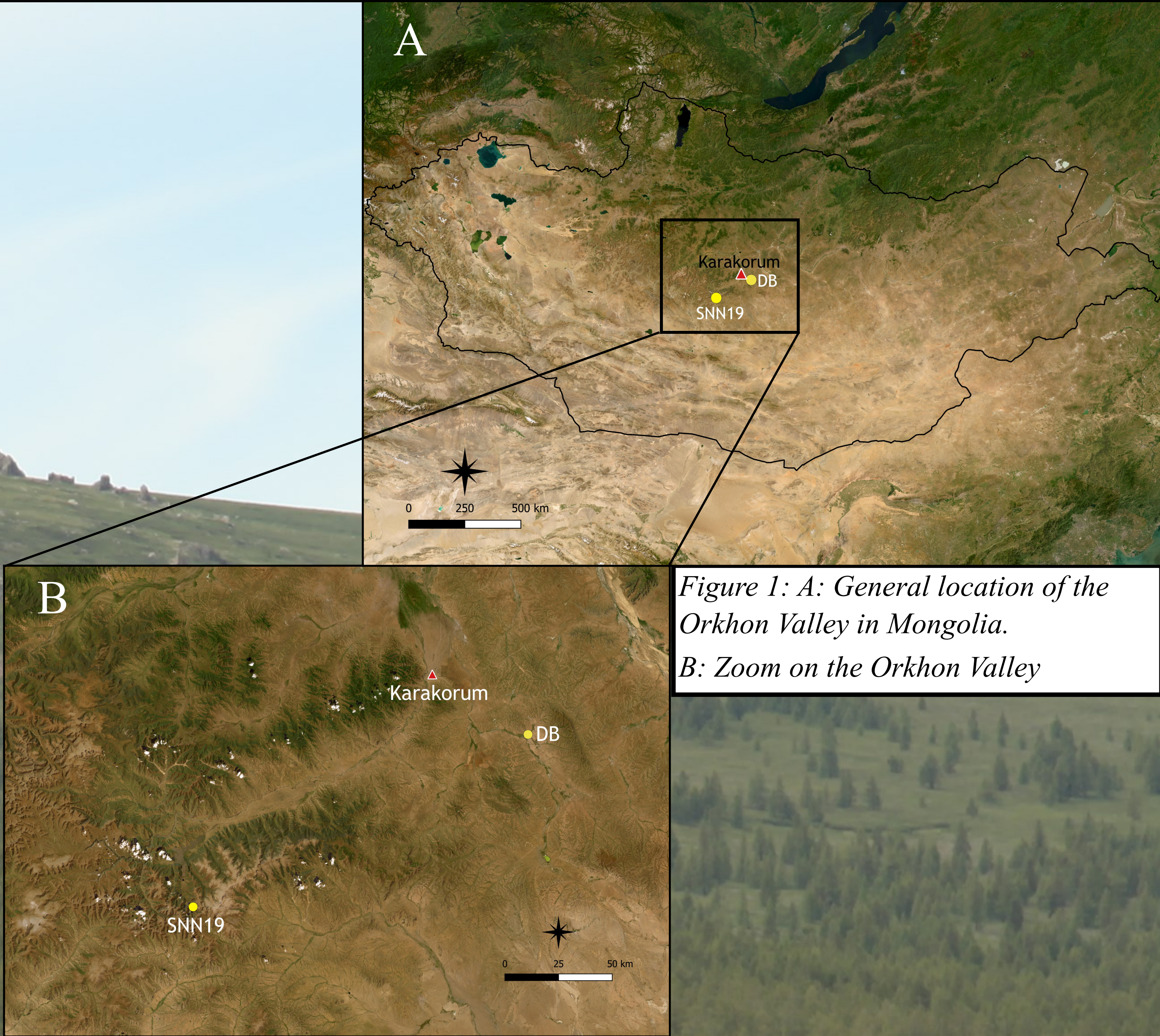


Figure 1: A: General location of the Orkhon Valley in Mongolia.
B: Zoom on the Orkhon Valley

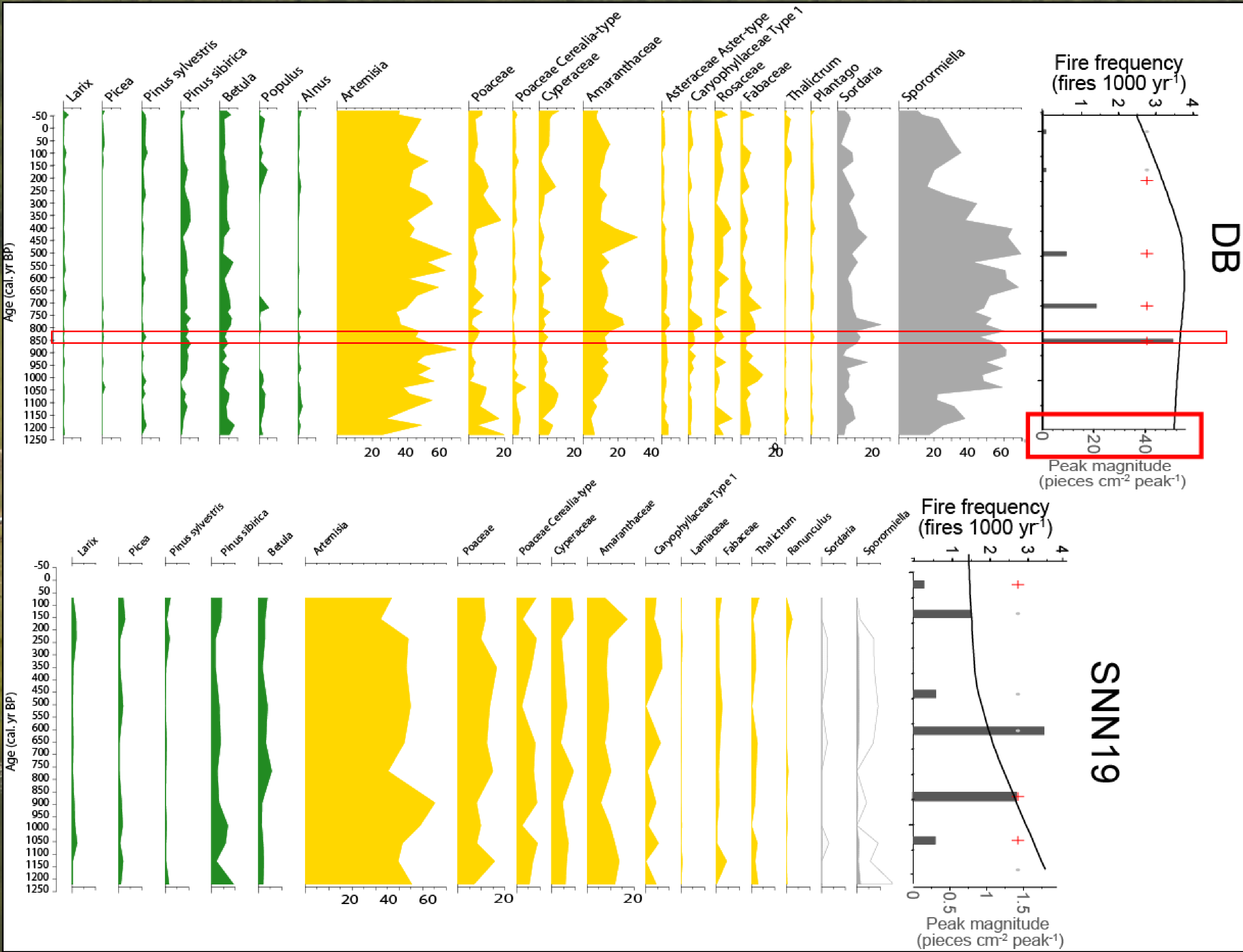


Figure 2: Comparison of main pollen taxa and fire activity between DB and SNN19 during the Late Holocene.

Results and discussion

The results of the palynological analysis show few differences between the DB site and the SNN19 site, which is surprising since the DB site being very close to the ancient capital Karakorum, we can expect an influence of human activities on vegetation, especially about Poaceae (Cerealia type for example). However, we can note a greater presence of *Betula sp.* at DB site, which could be the sign of more disturbances. This is also the case for Amaranthaceae, which may be a sign of human influence, as indicated by Wen *et al.* (2010), notably by the Chinese Liao, Jin and Yuan dynasties. Moreover, the major difference between the 2 sites is based on the NPP percentages of Sporormiella/Sordaria, spores spores of coprophilous fungi. Their presence is extremely rare at the SNN19 site, whereas they represent the main NPPs (with percentages going up to 60% for Sporormiella) at the DB site. This indicates the significant presence of large herbivores at DB site, and therefore the use of the land as pasture. This trace of human activity at the palynological level is also found at the level of fire activity since although the fire frequency between the 2 sites is of the same order (between 2 and 4 fires every 100 years, DB site showing the higher fire frequencies), the peak magnitudes are almost 30 times greater at the DB site, thus indicating a much higher intensity of fire events.

These results seem to show that the DB site was undeniably influenced by the presence of humans (NPP Sordaria/Sporormiella and fires), unlike the SNN19 site.

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