A synchronous change of mid- to late-Holocene hydroclimate and prehistoric population in coastal East Asia indicated by pollen, XRF and grain size data

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- Growing interest in a relationship between ancient cultures and climate change
  → Researches in many different regions around the world
  → Xie et al. (2013), Collins et al. (2017), Manning et al. (2017), Xu et al. (2019) etc.

- Nonetheless, a direct comparison between continuous and high-resolution climate proxies and archaeological data is in a starting stage in the Korean Peninsula
  → Constantine et al. (2019), Park et al. (2019) etc.

- Here, we analyzed pollen, XRF, and grain size from a core in the southern Korean Peninsula, and compared the data with summed probability distribution (SPD) of archaeological radiocarbon dates, which is an indicator for ancient population.

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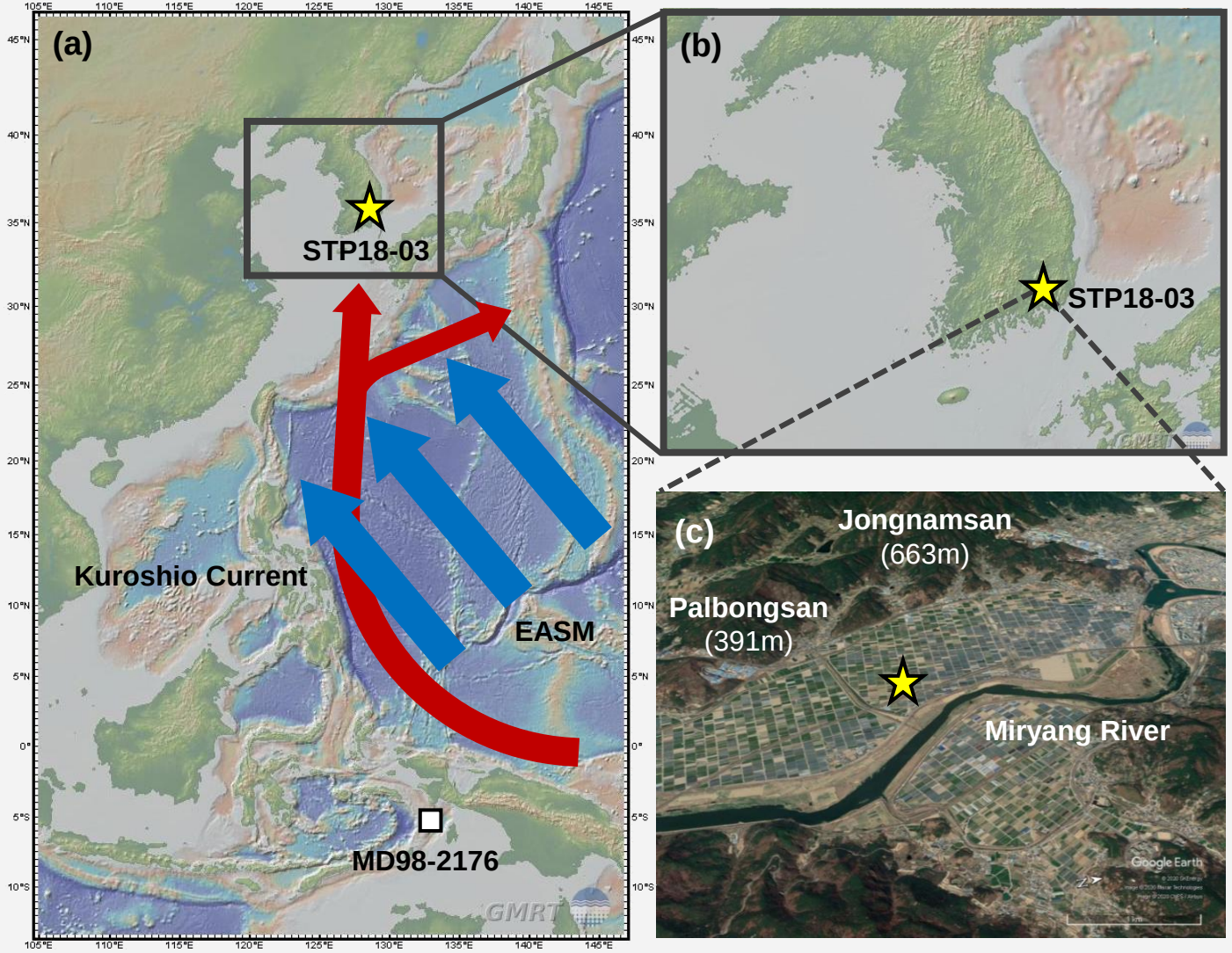
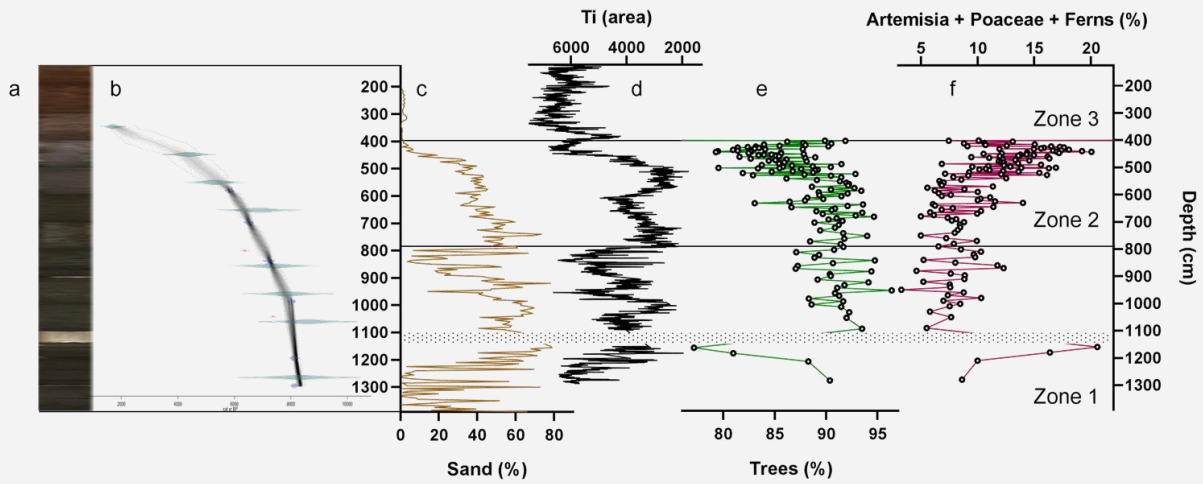
1 Introduction



Adapted from Ryan et al. (2009) and Google Earth software

- Core STP18-03 (yellow star)
  → 35°26′18″N, 128°46′41″E
  → floodplain of Miryang River, Korea
- XRF (0.5cm interval)
  Pollen (137 samples)
  Grain size (5cm interval)
- Chronology
  → 8 radiocarbon & 8 OSL dates
  → 14 of 16 dates used (bacon)

2 Materials and methods

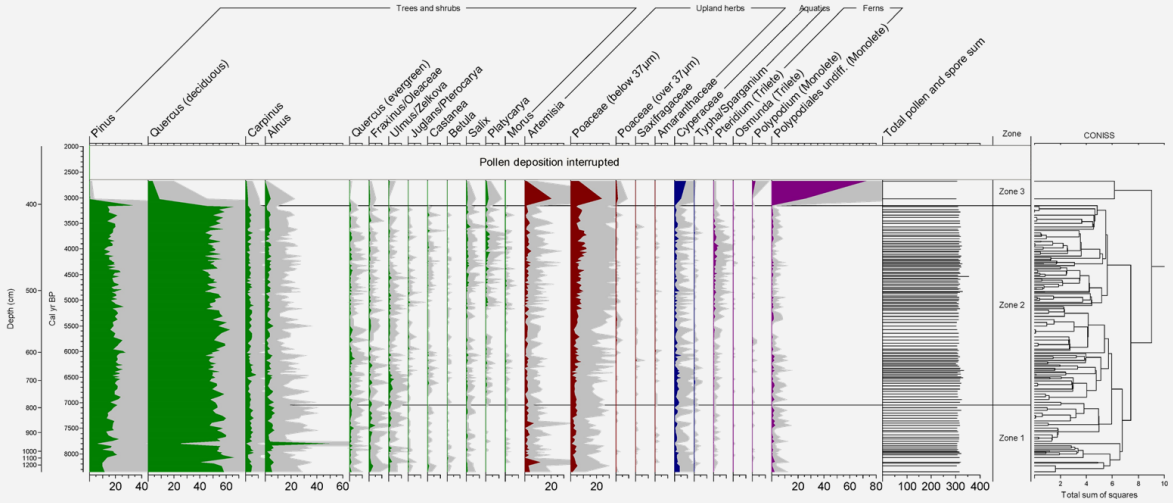


(c) Brown: sand percentage (%)

(d) Black: titanium content (area)

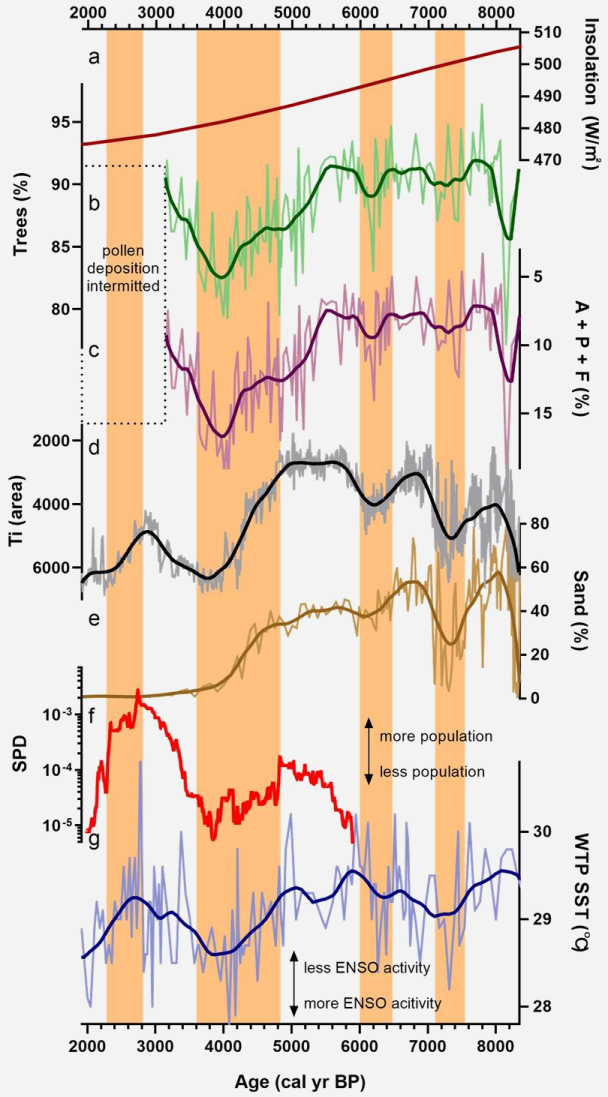
(e) Green: tree percentage (%)

(f) Magenta: *Artemisia* + *Poaceae* + ferns (%)



- The proxies are generally in phase
- Precipitation ↑, river discharge (sand) ↑, arboreal plant growth ↑, titanium erosion ↓
- Precipitation ↓, river discharge (sand) ↓, arboreal plant growth ↓, titanium erosion ↑

3 Results



(a) Crimson: June insolation at 30°N (W/m^2) (Berger et al., 1991)
(b) Green: tree percentage (%)
(c) Magenta: *Artemisia* (mugwort) + *Poaceae* (grass) + ferns (%)
(d) Black: XRF titanium content (area)
(e) Brown: sand percentage (%)
(f) Red: SPD of archaeological records in Korea (Oh et al., 2017)
(g) Blue: Western Tropical Pacific SST (℃) (Stott et al., 2004)

- Drier climate (b–e) are synchronous with lower ancient population (f)
  → ca. 4.8 – 3.6 ka & ca. 2.8 – 2.3 ka BP
  → Ancient societies in Korea were vulnerable to climate deterioration
- Active ENSO-like phase was a possible trigger for drier climate in the Korean Peninsula by dampening strength of East Asian Summer Monsoon (EASM) → vertical orange boxes

4 Discussion

- We conducted a multi-proxy analysis (XRF, pollen and grain size)
  on the hydroclimate change in the Korean Peninsula during ca. 8.3 - 2.3 ka BP.

- Periods of adverse climate conditions
  were synchronous with times when the density of archaeological records diminished.
  → Prehistoric cultures would have been
  vulnerable to climate deterioration during ca. 4.8 - 3.6 ka and ca. 2.8 - 2.3 ka BP.
  → Resource availability for hunter-gatherers and agricultural chance
  would have been confined due to precipitation deficits.

- Hydroclimate in the Korean Peninsula was likely modulated by the Pacific Ocean.
  → ENSO-like forcing dampened strength of the EASM

5 Conclusion

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6 Reference