

Late Holocene records of fire and human presence in New Zealand

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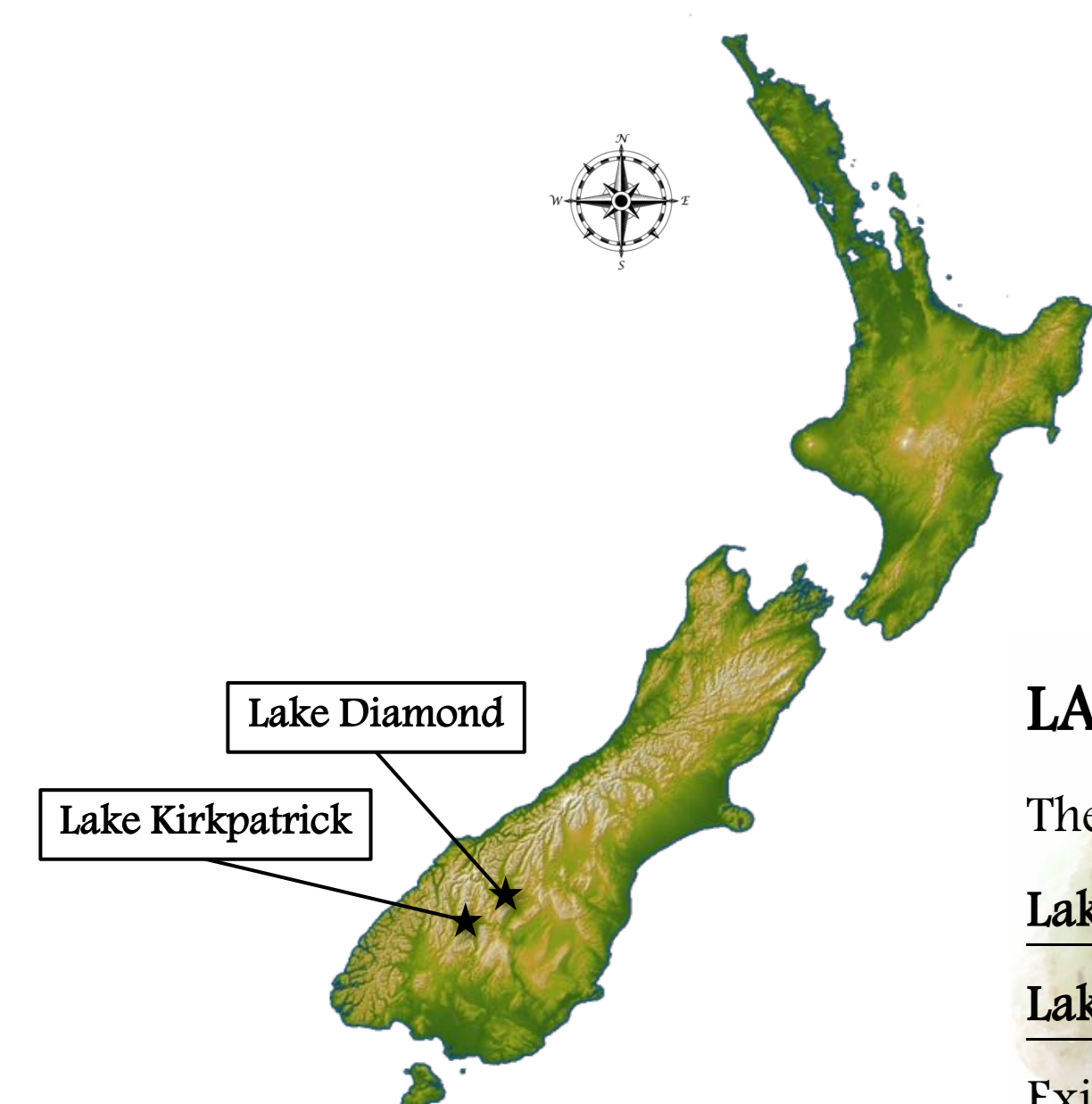
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The location: WHY NEW ZEALAND?



New Zealand, and in particular the South Island, is considered an excellent test site for studies about the **impact of early human settlements**. The **Polynesian settlement** occurred only about **700–800 years ago** and caused abrupt landscape modifications, with the **loss of 40–50% of the pre-existing forest**, which used to cover almost the 90% of New Zealand. A **shift in fire regime** and in the composition of vegetation is observed in **charcoal and pollen records** as a result of increased fire activity. Wildfires were infrequent before the advent of humans, and vegetation was not adapted to fire. Such an abrupt, fast and well documented transition, together with the isolated nature of New Zealand, make it a perfect study site for the reconstruction of local scale phenomena. The purpose of this study is to complement paleoecological information with molecular markers of fire (**PAHs: Polycyclic Aromatic Hydrocarbons**, **MAs: Monosaccharide Anhydrides**) and human presence (**FeSt: Fecal Sterols**) from **lake sediments**, in order to individuate when and how **anthropogenic land use** started to modify the environment irreversibly.

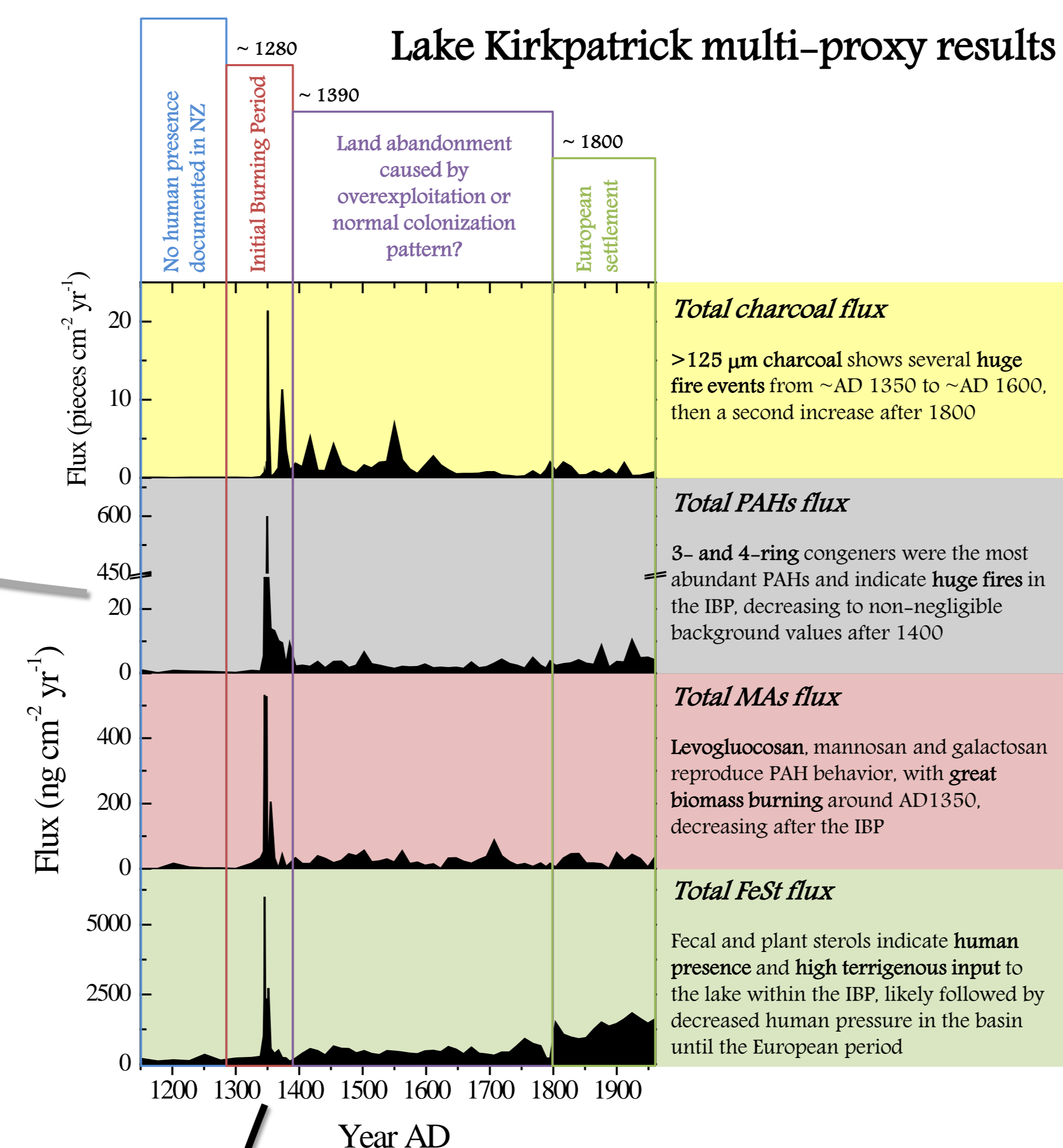
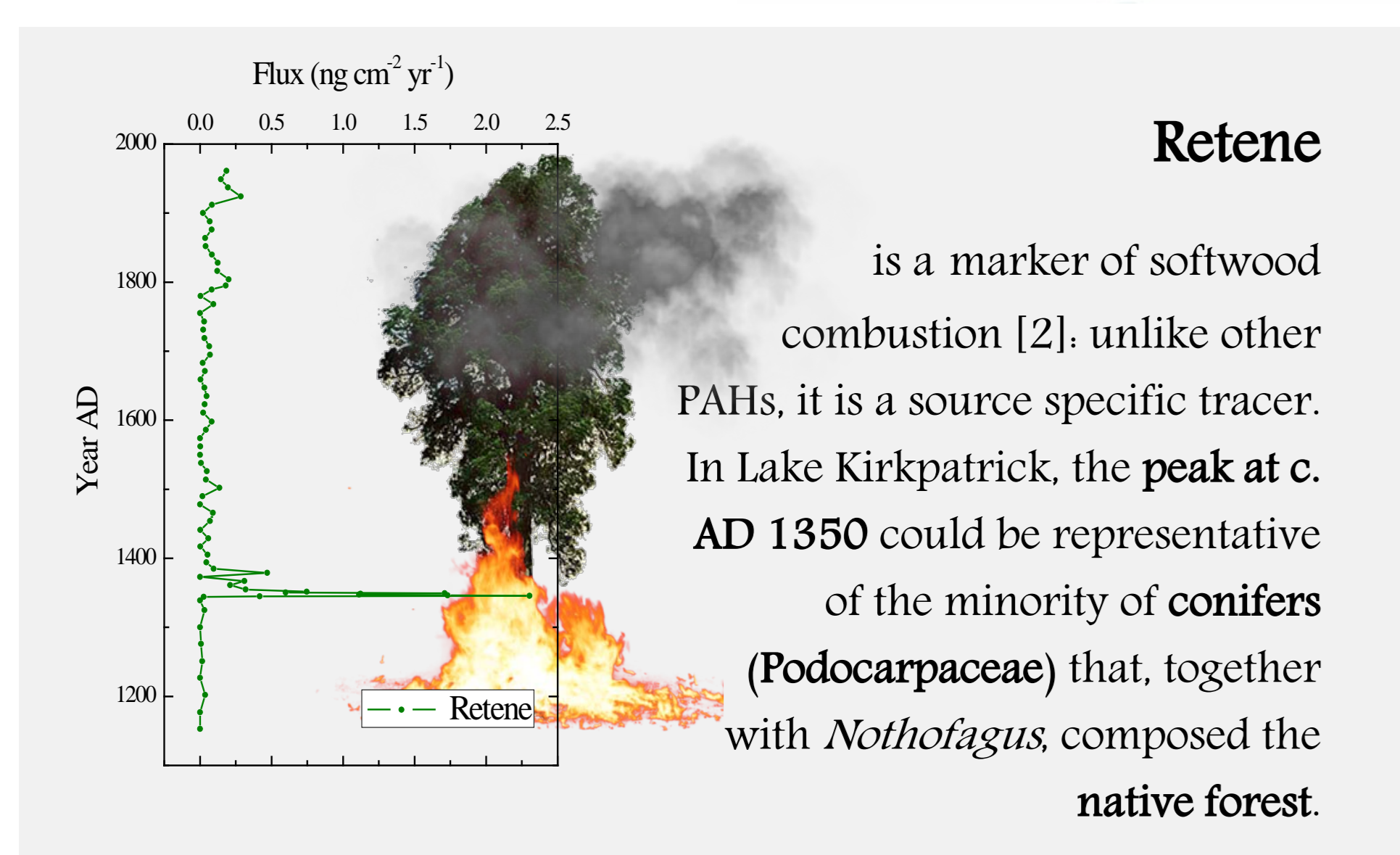
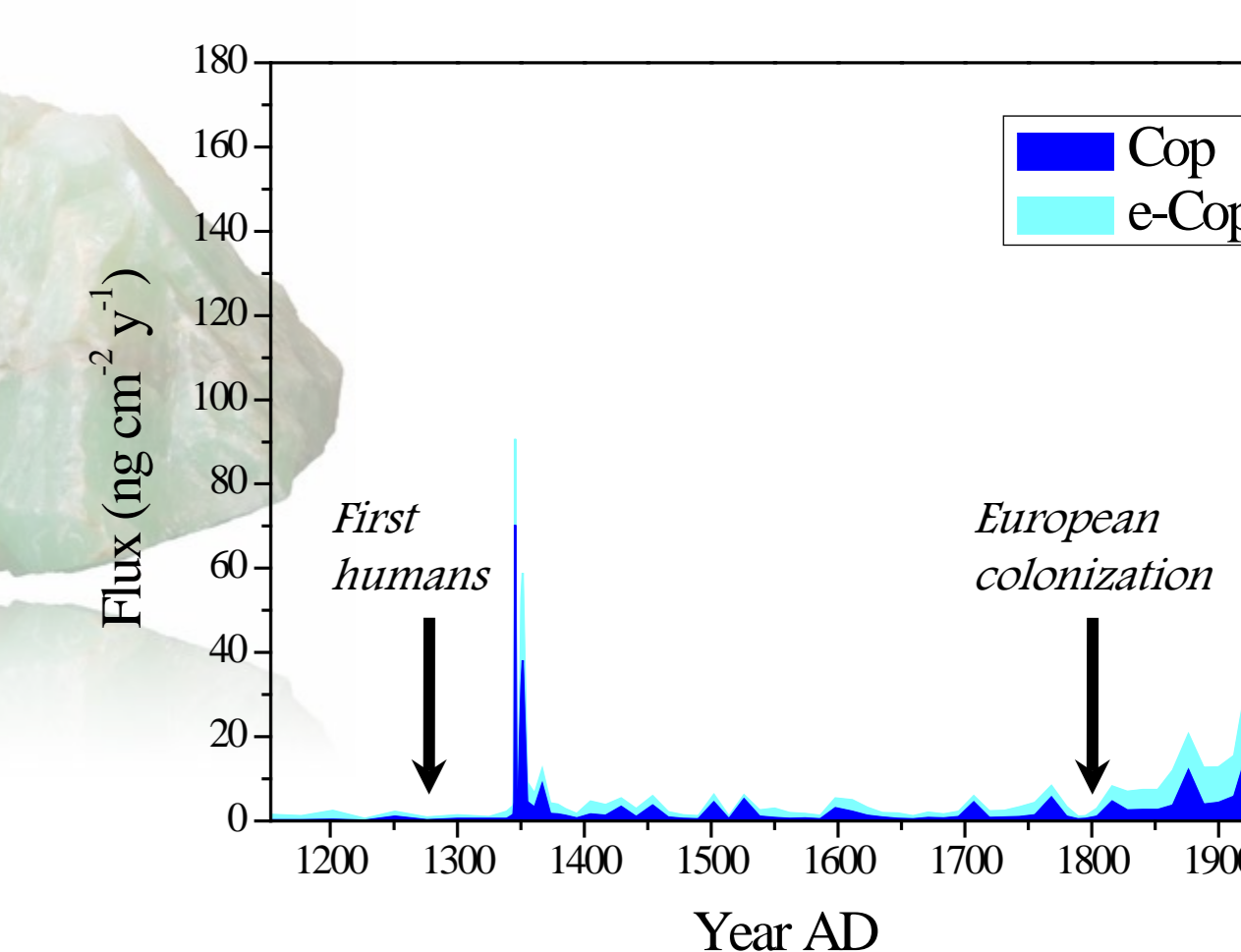
LAKE KIRKPATRICK and LAKE DIAMOND

The South Island is crossed for most of its length (500 km) by the **Southern Alps**, giving rise to many **valleys and lakes of glacial origin**, which serve as excellent repositories both for **atmospheric and terrigenous paleoenvironmental tracers**.

Lake Kirkpatrick (45.03° S, 168.57° E) is a small lake (~0.04 km²) located at 570 m asl in a moderate rainfall context within the Lake Wakatipu basin, in Otago, close to the Queenstown district and on the main Maori **jade trading route**.

Lake Diamond (44.65° S, 168.96° E, 1.6 km²) is located northeast of L. Kirkpatrick at 380 m asl, close to Lake Wanaka, and far from current settlements.

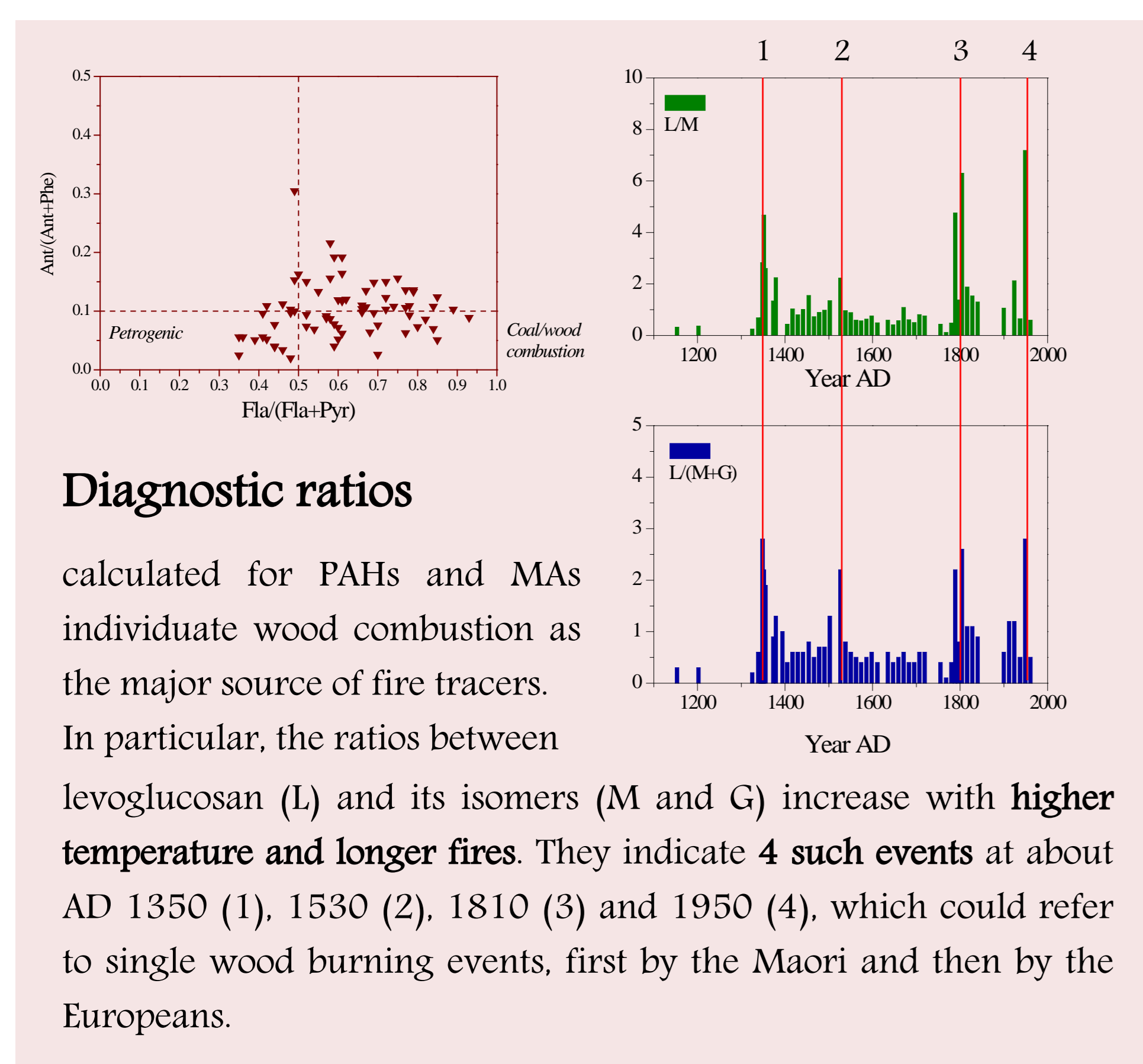
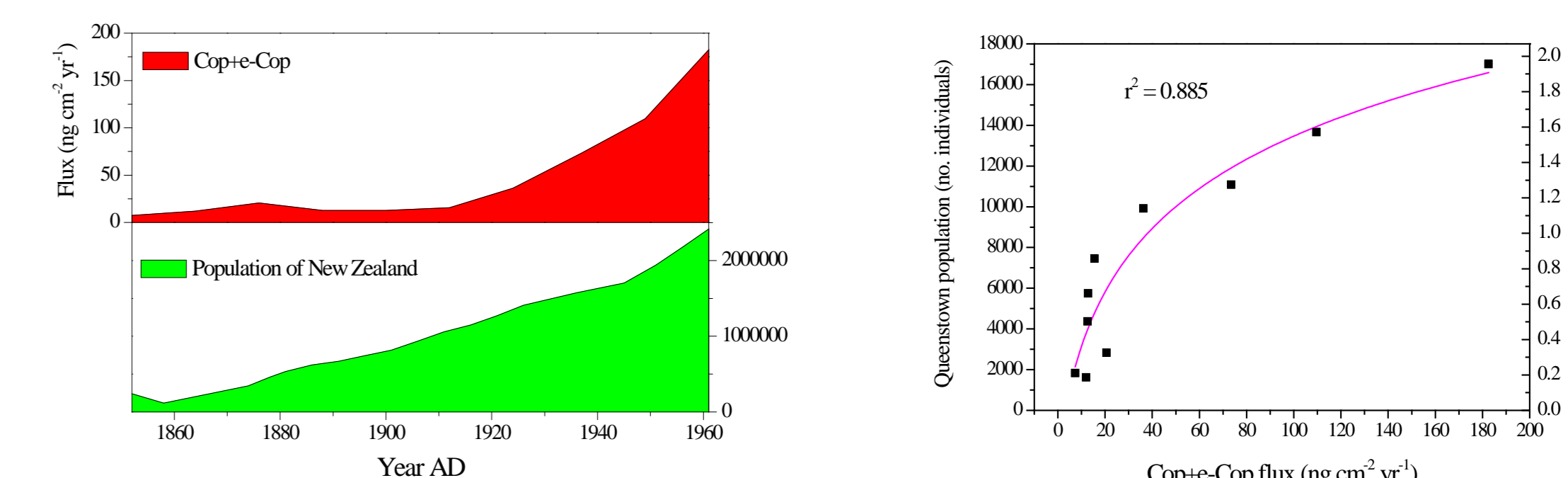
Existing fire records (charcoal) indicate **increased fire activity between AD 1300 and 1600**, corresponding to the replacement of tall trees (mainly *Nothofagus* and *Podocarpus*) by shrubland documented in pollen records [1].



Fecal Sterols And Population Size

Coprostanol (Cop) and its epimer **epicoprostanol (e-Cop)** are **specific tracers of human feces** [3]. They were measured in Lake Kirkpatrick and Lake Diamond; results show a clear indication of **human presence during the Initial Burning Period (IBP) after AD 1300**, then **decreasing significantly until the post-European increase in population**.

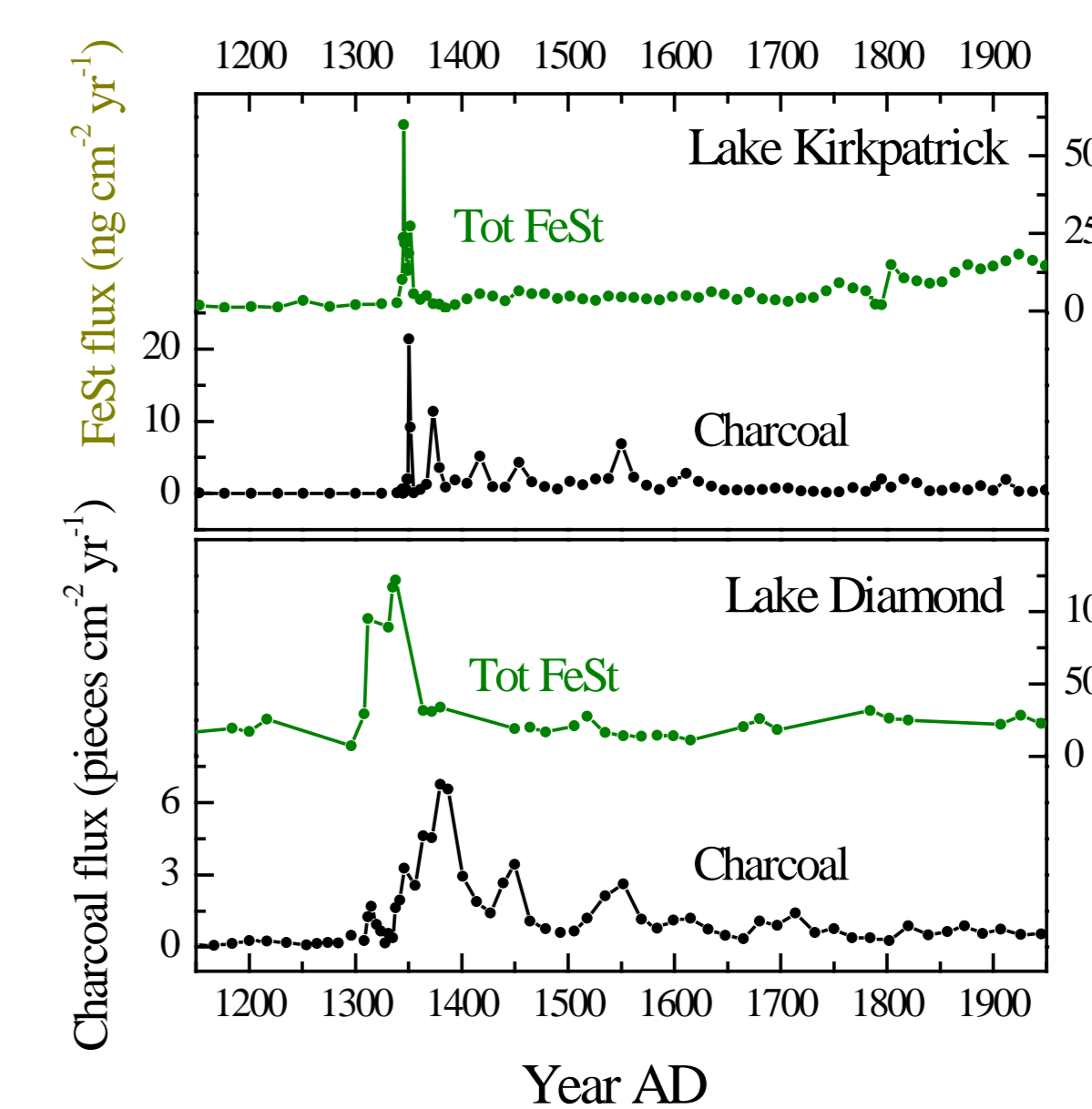
Population size of New Zealand and Queenstown was compared with Cop and e-Cop fluxes for the European period, resulting in a **logarithmic correlation (r² = 0.885)** and suggesting possible uses of FeSt for estimating past population densities.



Kirkpatrick VS Diamond

The comparison of FeSt results for the two lakes reveals an impressive **correspondence of the human signal with fire activity**. Fluxes were higher at LK, closer to human settlements.

Interestingly, a **temporal shift** between proxies is present in both lakes, more markedly at Lake Diamond: **fire lags human arrival** by one or more decades.



Different proxies give similar indications and confirm the anthropogenic origin of observed changes