

Abstract n°1582

## Introduction

The ecological and socioeconomic importance of mountains is being increasingly recognised. Such regions provide key ecosystem services, namely, water supply which benefits local as well as lowland human populations. Besides mountain aquifers and rivers, alpine lakes and ponds are crucial for water resources management but are also important in hydroecological and wildlife conservation terms.

This study aims at comparing the pollution of surface and underground water bodies by de-icing chemicals in a mountain environment. The influence of geological, geomorphological, pedological, climatic and anthropic conditions is taken into account.

## Materials and methods

The study region is the highest part of the Serra da Estrela, a Mediterranean mountain located in Central Portugal (see Figure 1). In this area there is a hydrological system which encompasses water-table aquifers and number of alpine ponds of glacial origin situated between 1500 m a.s.l. and the summit (1993 m a.s.l.). In the study area, the alpine ponds and springs were inventoried. Water sampling campaigns were carried out for hydrogeochemical characterisation of alpine ponds. These results were compared with hydrogeochemical data from water springs obtained in previous studies.

Concentration of the following analytes were determined: total organic carbon (TOC), metals (Pb, Zn, Fe, Cu, Ni, Cd, Cr, As, Mn), cations ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ), anions ( $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ), silica ( $\text{SiO}_2$ ) and nutrients (N, P). Additionally, parameters such as pH, conductivity, turbidity and alkalinity were also measured.

## Results / Discussion

The hydrogeochemistry of alpine ponds and water table aquifers affected by de-icing chemicals is clearly different from the one showed by non-polluted water bodies, due to the influence of different physical settings as well as to the spatial distribution of the anthropic influence (see Fig. 2). The de-icing contamination is shown through higher  $\text{Na}^+$ ,  $\text{Cl}^-$  and  $\text{Ca}^{2+}$  levels.

The **springs** located downstream from roads (nave de Santo António Sul, Espinhaço de Cão, Mina da Torre and Lagoa Comprida) are, in all cases, contaminated, whereas those located upstream from roads are not affected. The Mina da Torre spring shows the highest contamination level due to the more intensive use of de-icing chemicals with the purpose of assuring the access to the most popular touristic area in the Serra da Estrela mountain.

The **alpine ponds** hydrogeochemistry is similar to the one observed in springs (see Fig. 3). In pond L6 and pond L3, the contamination results from the flow of surface and/or underground water affected by road pavement runoff.

Due to its geological, geomorphological and climatic characteristics, the Serra da Estrela mountain plays a strategic role in the water management in Portugal. The hydrogeochemical results illustrate the process of alpine ponds and aquifer contamination that affects water quality and may also disturb the local highly sensitive aquatic ecosystems.

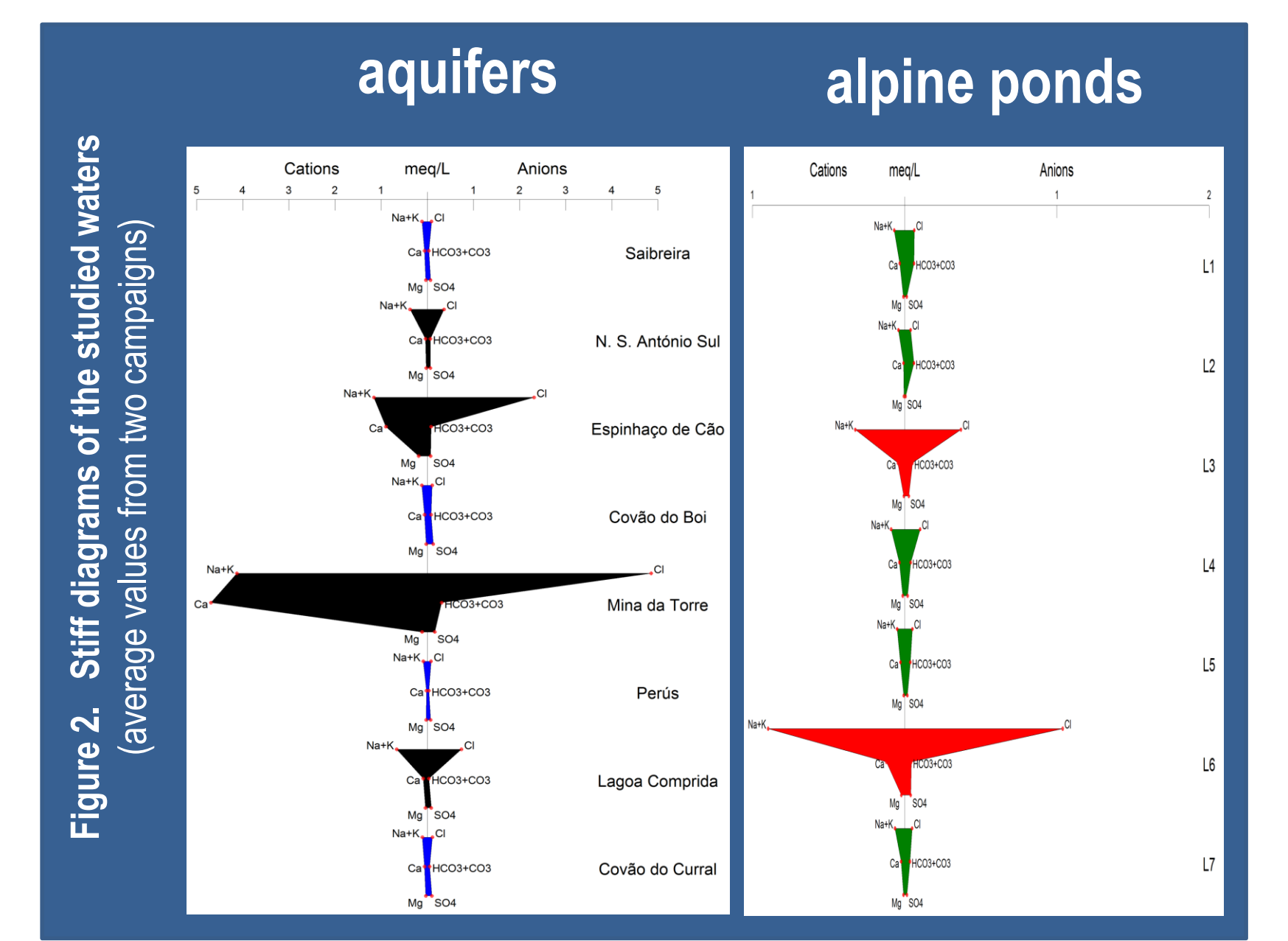


Figure 2. Stiff diagrams of the studied waters (average values from two campaigns)

## Study Area

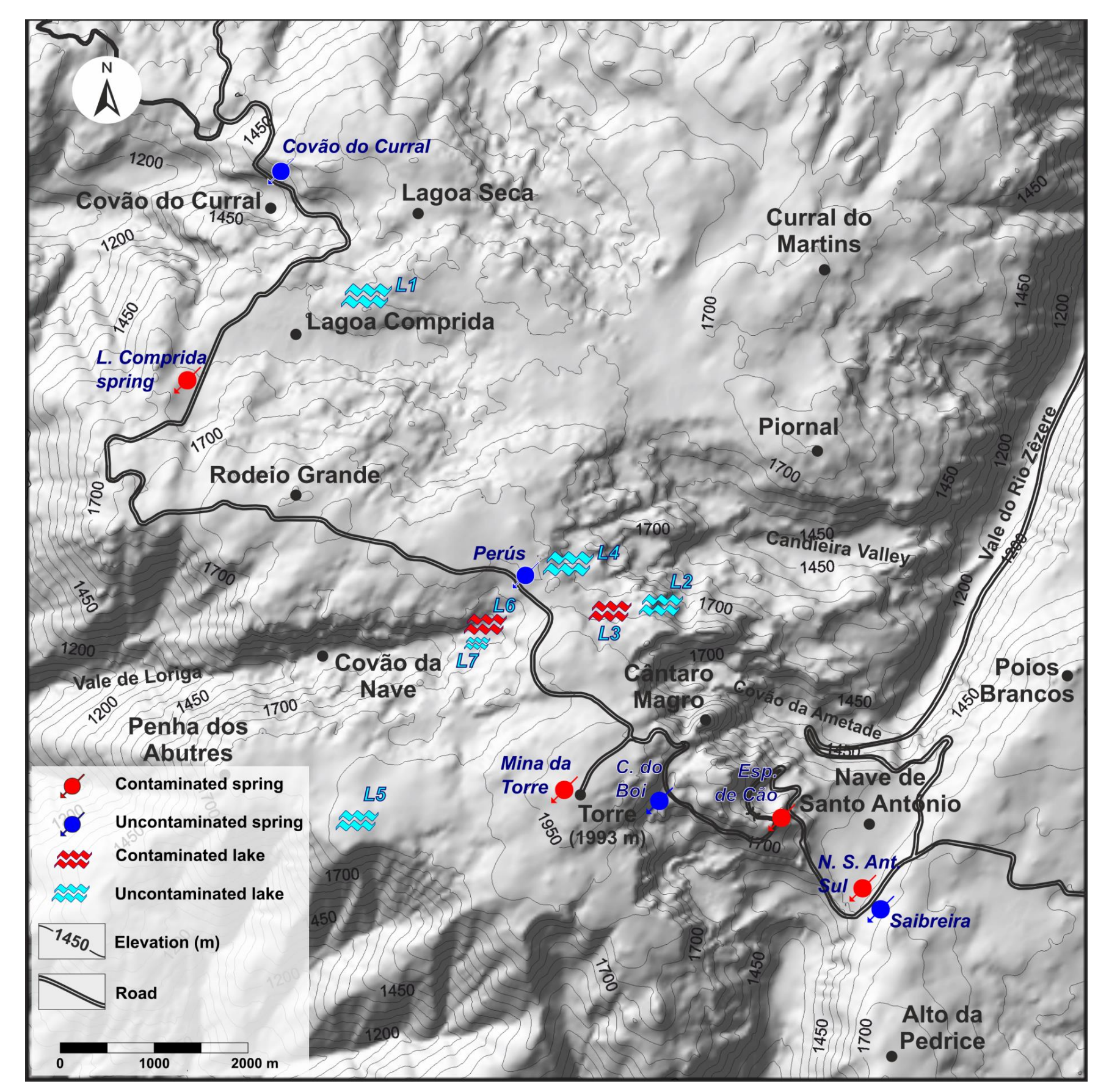
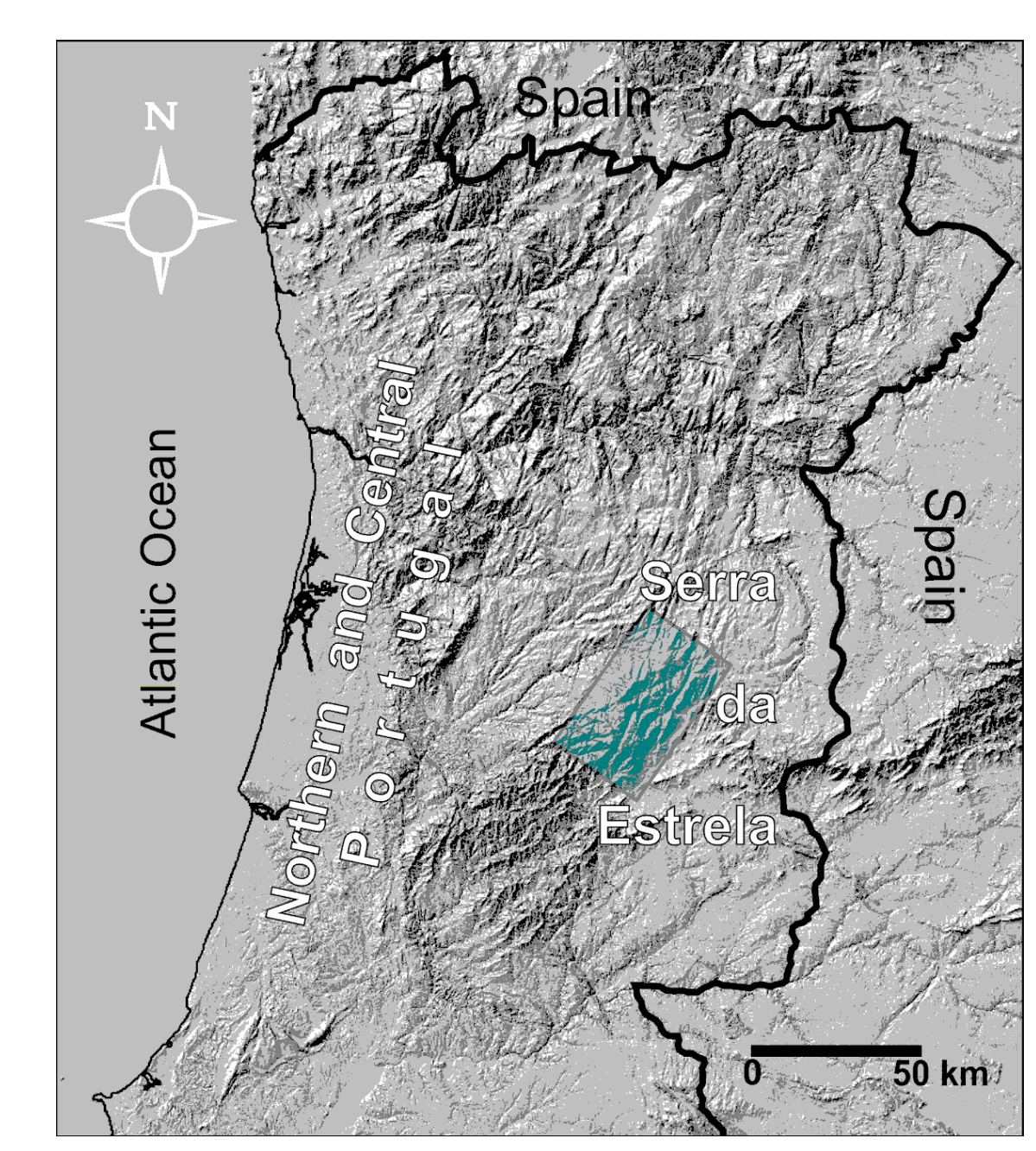


Figure 1. Location of Serra da Estrela springs and alpine ponds



References  
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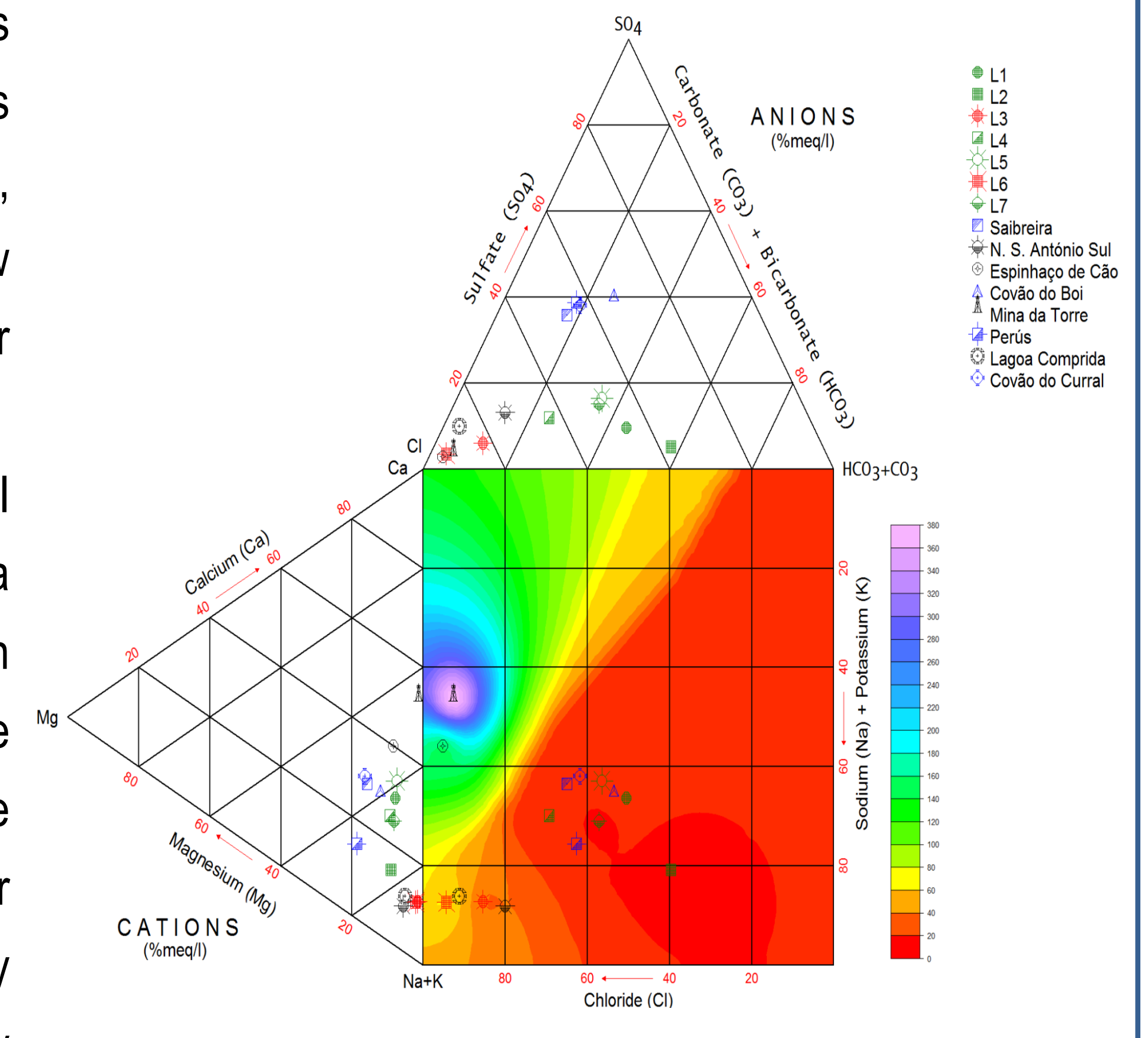


Figure 3. Durov diagram of Serra da Estrela springs and alpine ponds

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