

Interactive comment on “Biomass uptake and fire as controls on groundwater solute evolution on a southeast Australian granite: aboriginal land management hypothesis” by J. F. Dean et al.

Anonymous Referee #1

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General comments:

The manuscript by Dean et al. provides an interesting case of how processes other than water-rock interaction may govern groundwater chemistry in arid regions. It adds some new aspects of catchment functioning that are revealing in particular for researchers active in more humid regions. The paper is well structured and written and the argumentation is conclusive for the most part. There are a few points that should be further addressed:

Obviously, the chloride concentration in precipitation is the basis and, thus, critical for this balance. Consequently, the reader should know more about the used data.

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How many samples were considered from each station? How large is the temporal variability? Was only rainfall sampled or total deposition? Regarding your hypothesis that large amounts of elements are exported via smoke, it could be possible that a part of that is re-imported as dry deposition.

Since groundwater ages in the study area are some thousands of years it is unclear to what degree modern precipitation is representative for the whole period of groundwater recharge. Maybe more chloride was imported in former times by different wind systems in a different climate. If you consider, e.g. a Cl⁻ concentration in precipitation increased by only 50 % you will no more find a depletion of Mg⁺⁺, Na⁺ and H₄SiO₄. On the other hand, the depletion of the macro nutrients K⁺, Ca⁺⁺, and SO₄⁻ is not sensitive to variable Cl⁻ concentrations in precipitation. This could additionally strengthen your hypothesis that at least the concentrations of some macronutrients in groundwater are controlled by plant uptake.

Generally, it remains rather unclear how the export of elements happens. Are they transformed to gas phase by burning or are they emitted as particles. In the latter case, also an import of particles following fires in adjacent catchments has to be taken into account. If nutrients are easily leached out of ash, the export via streams would require surface runoff. Is that a common process in the study area?

Specific comments:

p. 1836, l. 28: Please indicate the slope of the isocon or the weight-% measured for Zr.

p. 1842, l. 26 ff. / Table 10: The calculation of fire frequencies considers that 100% of elements stored in the biomass are exported during the fire. This is for sure not the case.

Table 9: It is unclear how this was calculated. What does the first line tell?

p. 1844, l. 18 ff.: These results are probably only applicable to arid regions with rocks

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that are poorly soluble (as granite). In a limestone aquifer this might look different. Tables: Please use homogeneous concentration units. As long as no charge balances or chemical reactions are calculated, concentrations in mg l⁻¹ are probably most convenient (as in Table 1). [Mol l⁻¹ x 10⁵] is difficult for most readers.

Table 5: HCO₃⁻ is highly unconservative, so the balance for that ion may be omitted.

Technical corrections:

p. 1834, l. 26: Figure 5 does not fit here. Do you mean Fig. 6?

p. 1836, l. 4: I guess this time you mean Fig. 5.

p. 1840, l. 1: Here it should be Fig. 6 again.

p. 1840, l. 11: This should be Tab. 3

Table 3: unit should be "mol/l"

Table 9: Omit "molar" in the caption. If percentages are given this does not play a role (see also p. 1840, l. 8).

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