# Supplementary Information for

## Investigations into whole water, prototropic and amide proton exchange in lanthanide(III) DOTA-tetraamide chelates

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# Supplementary Information S1

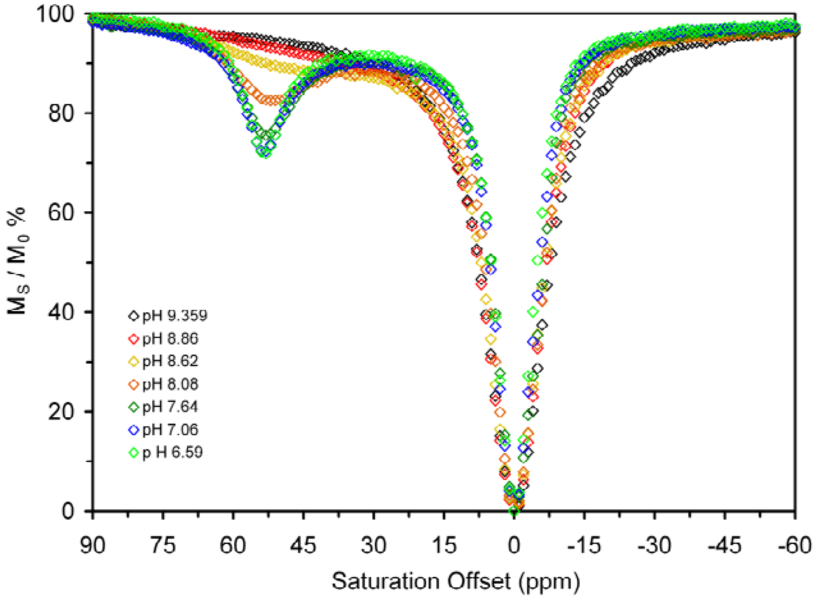

**Figure S1.** The CEST spectra of a 10mM aqueous solution of Eu**1** recorded at 500 MHz, 298 K, $B_1$ = 1 kHz, irr. time = 2 s.

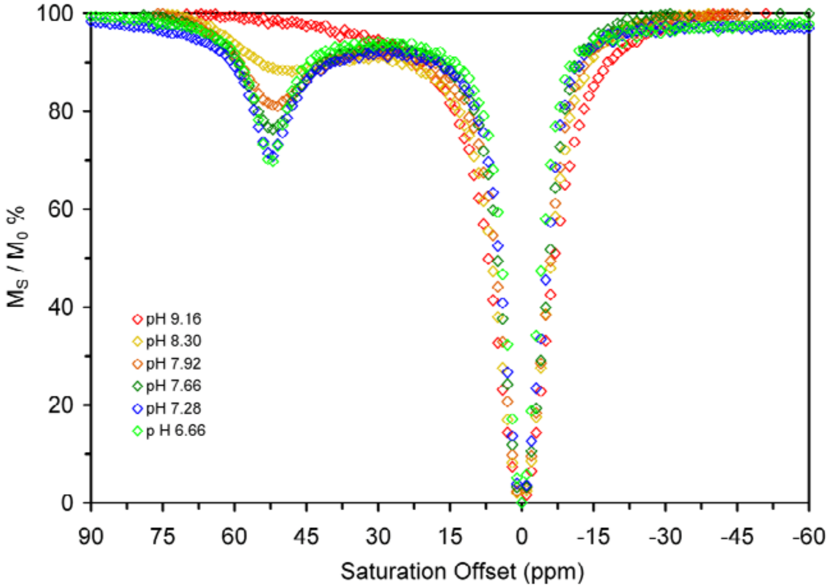

**Figure S2.** The CEST spectra of a 10mM aqueous solution of Eu**2** recorded at 500 MHz, 298 K, $B_1$ = 1 kHz, irr. time = 2 s.

# Supplementary Information S2

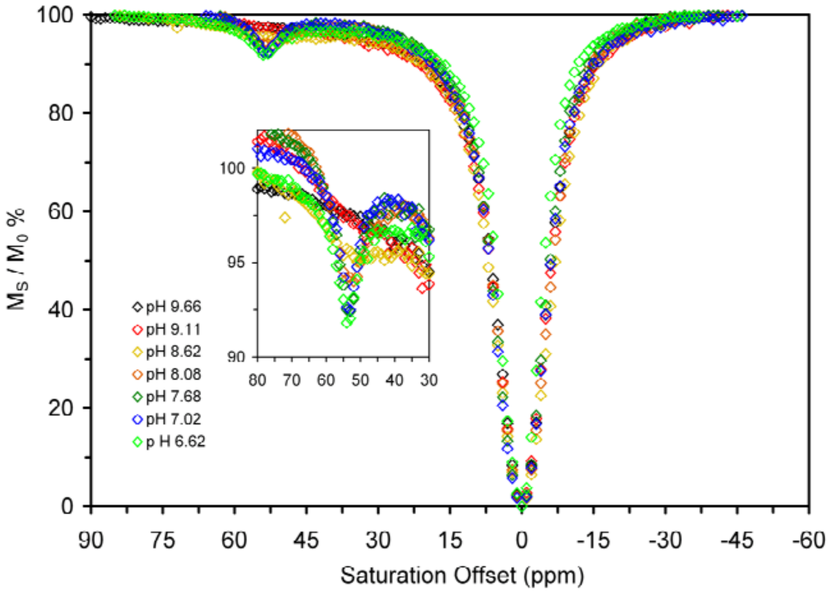

**Figure S3.** The CEST spectra of a 10mM aqueous solution of Eu**3** recorded at 500 MHz, 298 K, $B_1$ = 1 kHz, irr. time = 2 s.

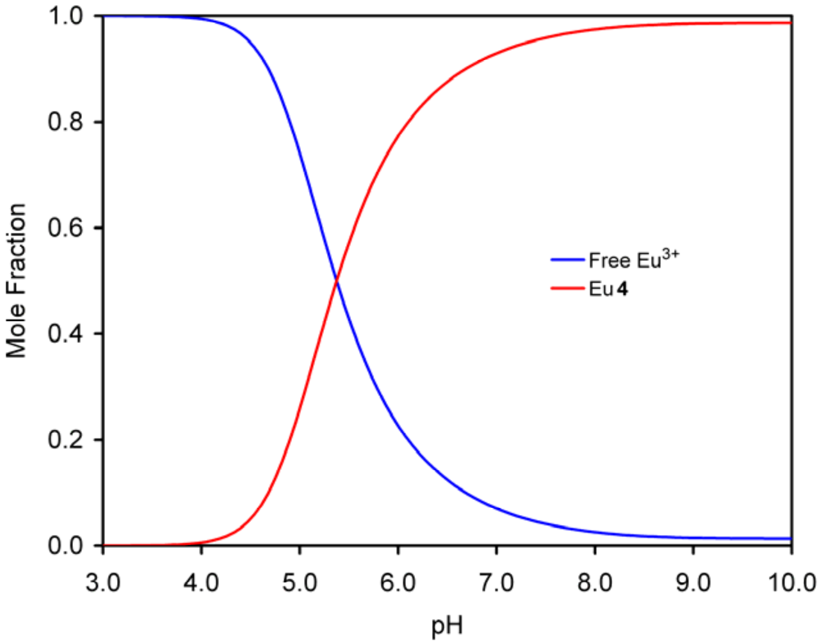

**Figure S4.** The speciation diagram, showing the dissociation of Eu**4** in acid

# Supplementary Information S3

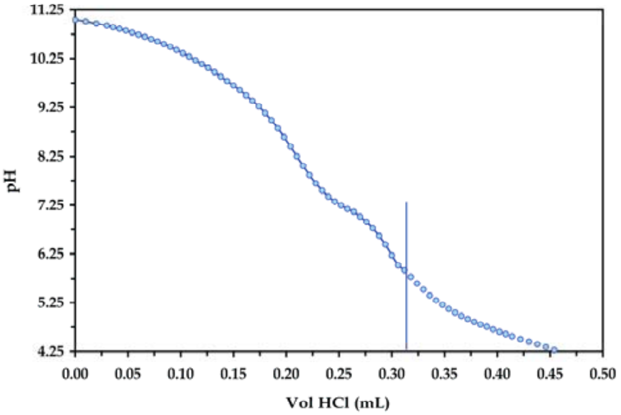

**Figure S5.** Data from the titration of Eu**4** (0.9917 mM, $V_t$=11.33 mL) against HCl (0.1337 M), experimental data are the points and the solid line represents the calculated fit from pH 11 to 6 (fitting parameter, ΔV = $5.01 \times 10^{-3}$ mL). The fitting procedure is described below.

The pH of a sample of Eu**4** was adjusted to 11 using a KOH solution under an argon atmosphere. The absence of unchelated $Eu^{3+}$ was confirmed by a negative xylenol orange test (0.5 M acetate buffer, pH = 4.76). The sample was then back titrated against a standardized HCl solution (0.1337 M) in the pH range of 11.1 – 4.1.

The protonation constants are defined by the following equations:

$EuL + OH^- = EuLH_{-1} + H_2O$ $$\log K_1^{H} = \frac{[EuLH_{-1}]}{[EuL][OH^-]}$$ ($\log K_1^{H} = 7.14$)

$EuLH_{-1} + OH^- = EuLH_{-2} + H_2O$ $$\log K_1^{H} = \frac{[EuLH_{-2}]}{[EuLH_{-1}][OH^-]}$$ ($\log K_2^{H} = 9.19$)

The protonation constants thus obtained were then compared to those obtained previously for the free ligand (*Inorg. Chem.* (2007), **46**, 2584) and published data for the $CO_3^{2-}/HCO_3^{-}/H_2CO_3$ system (D.R. Lide, *CRC Handbook of Chemistry and Physics*, 71th ed. Boca Raton, Ann Arbor, Boston: CRC Press, 1990-1991). This ensures that the calculated protonation constants can be directly attributed to the chelate and not free ligand or carbonate present in the KOH solution used to set the pH in the initial stage of the measurement. These protonation constants are collected in Table S1 and show that the protonation event in Figure S5

# Supplementary Information S4

can be attributed to the chelate Eu**4** since any other source would give rise to different protonation constants than those observed.

**Table S1.** Protonation constants for Eu**4**, the ligand **4** and the carbonate/bicarbonate system

| | Eu**4** | **4** | $CO_3^{2-}/HCO_3^-/H_2CO_3$ |
|---|---|---|---|
| log $K_1^H$ | 7.14 (0.05) | 5.51 | 6.37 |
| log $K_2^H$ | 9.19 (0.03) | 8.44 | 10.25 |