Supporting Information

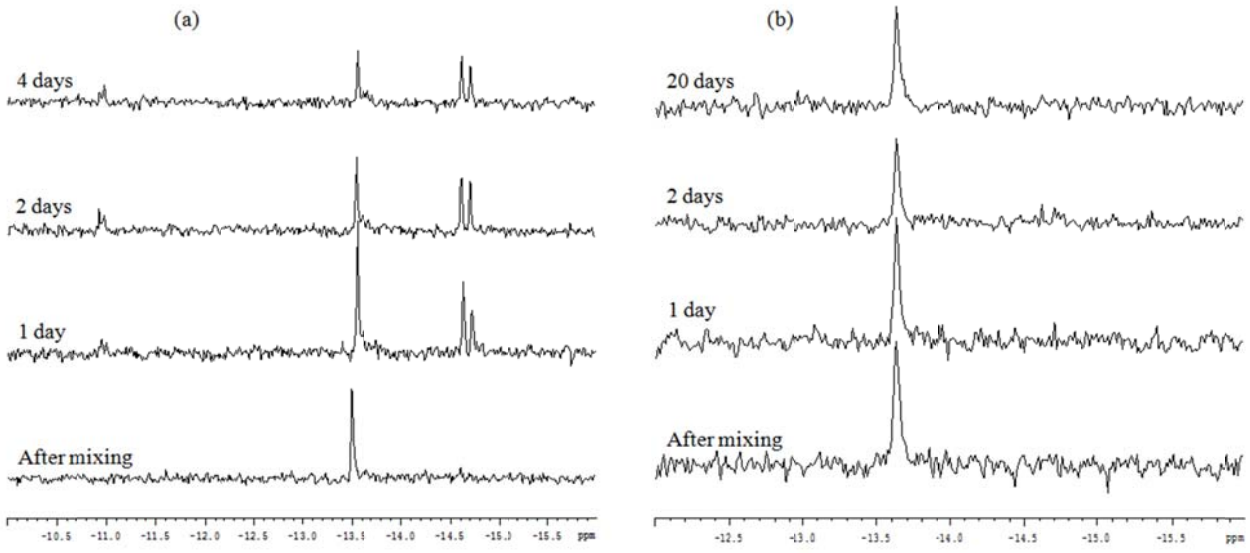

Figure S1.[31]P NMR spectra of 2 mM solution of **1** at 60 °C and (a) pD 7.4 and (b) pD 5.4.

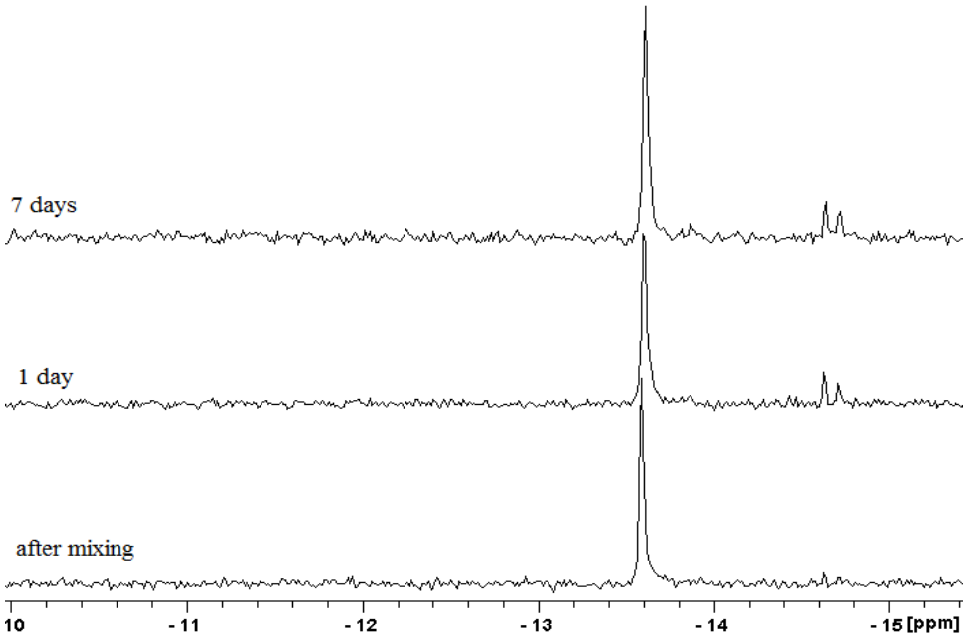

Figure S2. [31]P NMR spectra of 6.0 mM **1** at 60 °C and pD 5.4, measured after mixing, after 1 day and 7 days.

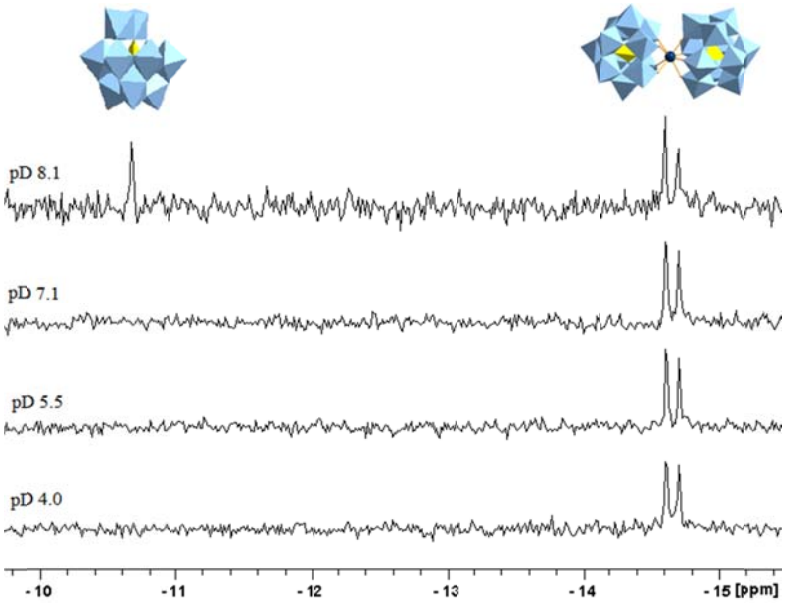

Figure S3. ^{31}P NMR spectra of 2.0 mM solution of **2** at different pD values.

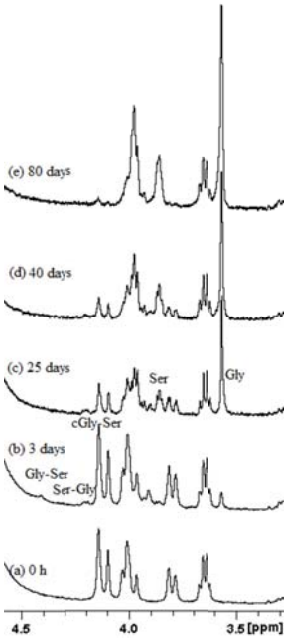

Figure S4. ^{1}H NMR spectra recorded at different reaction times during the hydrolysis of 2.0 mM cGly-Ser by 2.0 mM **1** at pD 5.4 and 60 °C.

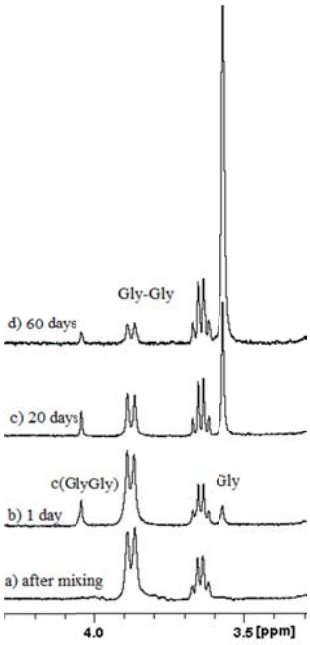

Figure S5. ^{1}H NMR spectra recorded at different reaction times during the hydrolysis of 2.0 mM Gly-Gly by 2.0 mM **1** at pD 5.4 and 60 °C.

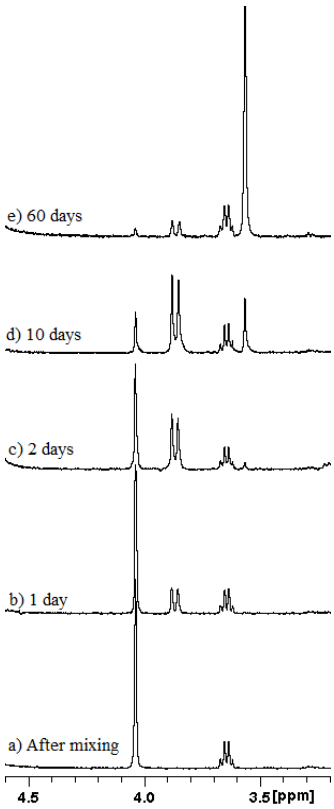

Figure S6 ^{1}H NMR spectra recorded at different reaction times during the hydrolysis of 2.0 mM cGly-Gly by 2.0 mM **1** at pD 5.4 and 60 °C.

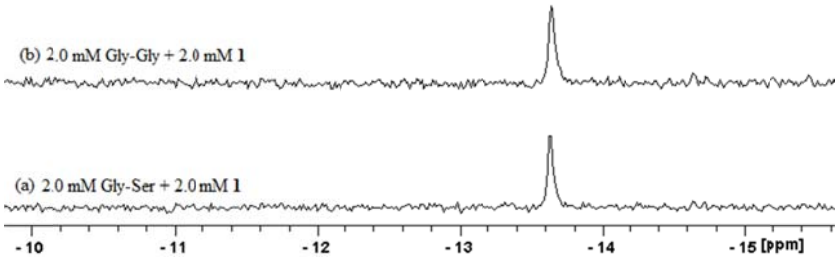

Figure S7. ^{31}P NMR spectra of 2.0 mM **1** in the presence of the dipeptide at pD 5.4 and 60 °C recorded after 7 days (a) and after 2 months (b).

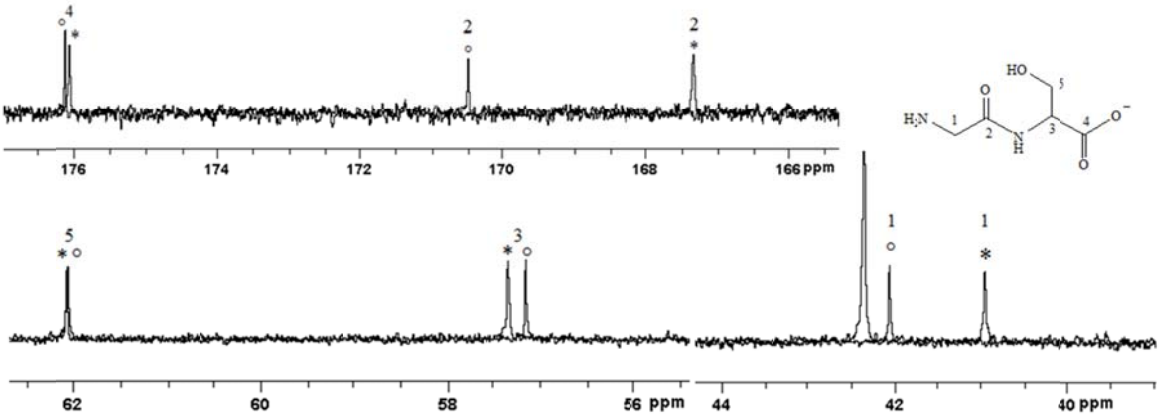

Figure S8. ^{13}C NMR spectra of Gly-Ser in the presence (*) and absence (º) of **1** at pD 9.0 (The signal at 42.4 ppm belongs to the CH_2 carbon of the ethyl group of the diethyl ammonium counter ions of **1**).

Table S1. ^{13}C NMR chemical shift values (ppm) of 20.0 mM Gly-Gly in the presence and in the absence of 5.0 mM **1**.

^{13}C NMR	pD 6.4			pD 9.0		
	Gly-Gly	Gly-Gly + **1**	Δδ (ppm)	Gly-Gly	Gly-Gly + **1**	Δδ (ppm)
δ_1	40.72	40.62	0.10	42.47	40.99	1.48
δ_2	167.40	167.06	0.34	171.87	167.90	3.97
δ_3	43.27	43.29	0.02	43.16	43.32	0.16
δ_4	176.49	176.48	0.01	176.63	176.55	0.08

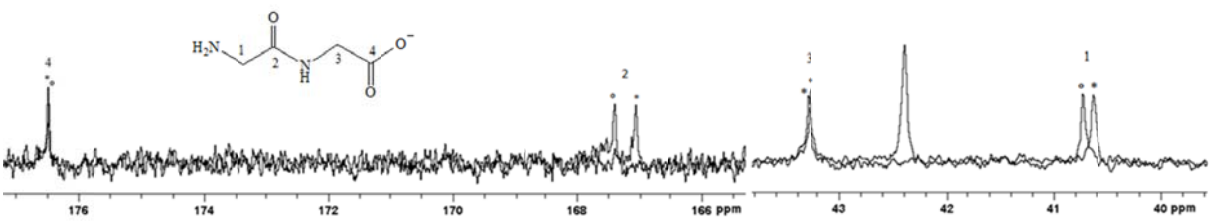

Figure S9. ^{13}C NMR spectra of Gly-Gly in the presence (*) and absence (º) of **1** at pD 6.4 (The signal at 42.4 ppm belongs to the CH_2 carbon of the ethyl group of the diethyl ammonium counter ions of **1**).

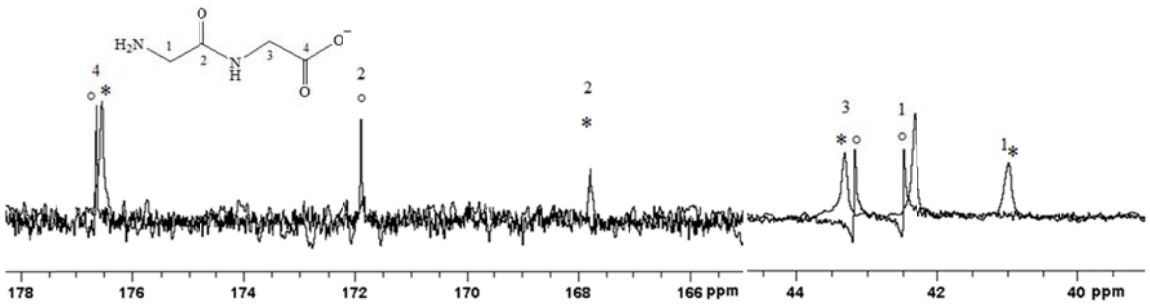

Figure S10. ^{13}C NMR spectra of Gly-Gly in the presence (*) and absence (º) of **1** at pD 9.0. (The signal at 42.4 ppm belongs to the CH_2 carbon of the ethyl group of the diethyl ammonium counter ions of **1**).

Table S2. Influence of pD on k_{obs} for the hydrolysis of 2.0 mM Gly-Ser in the absence and in the presence of 2.0 mM **1** at pD range 3.6 – 8.4 and 60 °C.

pD	10^7 x k_{obs} (s^{-1})		
	Gly-Ser	Gly-Ser + **1**	Δ
8.4	0.83	30.77	29.94
7.4	1.94	34.67	32.73
6.4	1.39	47.23	45.84
5.4	1.39	63.33	61.94
4.5	0.56	44.21	43.65
3.6	0.28	29.43	29.15

Table S3. Observed rate constants for the hydrolysis of 2.0 mM Gly-Ser or 2.0 mM Gly-Gly by different metal-based catalysts.

Catalyst	Experimental conditions	k_{obs} (s^{-1})		Ref
		Gly-Ser	Gly-Gly	
$ZnCl_2$ (10.0 mM)	pH 7, 70 °C	205.1×10^{-7}[a]	7.16×10^{-7}[a]	[14b]
Na_2MoO_4 (120.0 mM)	pH 7.0, 60 °C	59×10^{-7}		[28a]
Zr(IV)/4, 13-Diaza–18–crown–6 (10.0 mM)	pH 7.0, 60 °C	294.5×10^{-7}	319.8×10^{-7}	[15]
Cu(II)-cis,cis-1,3,5-triaminocyclohexane (2.0 mM)	pH 8.1, 70 °C	255.5×10^{-7}	11.39×10^{-7}	[18c]
Zr-Wells Dawson POM (2.0 mM)	pH 4.6, 60 °C	34.0×10^{-7}	15.8×10^{-7}	[12a]
Zr-Keggin POM (2.0 mM)	pH 5.0, 60 °C	63.33×10^{-7}	4.44×10^{-7}	This work

[a] [dipeptide] = 10.0 mM

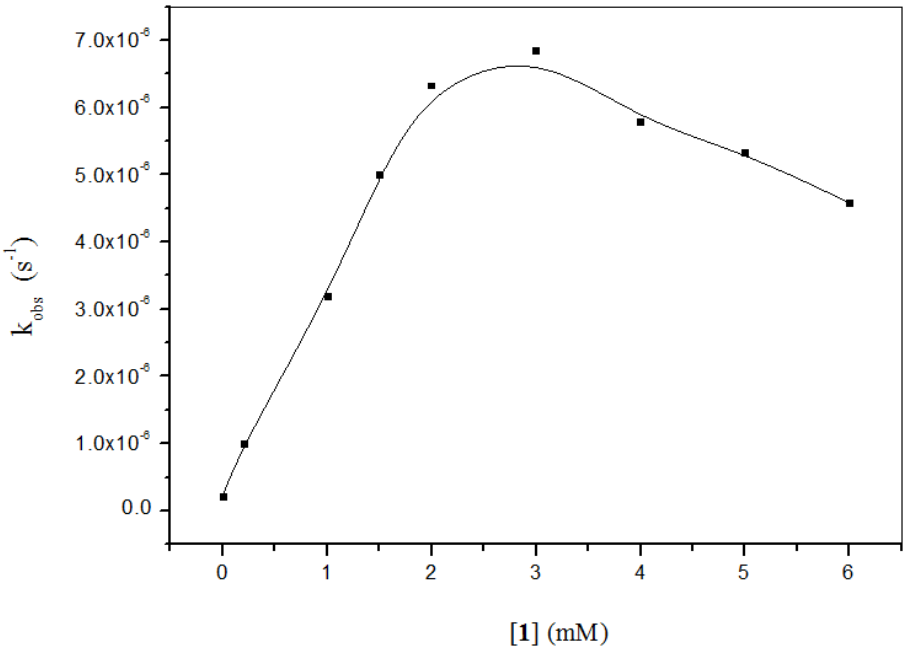

Figure S11. Influence of the concentration of **1** on the observed rate constant for the hydrolysis of 2.0 mM Gly-Ser at pD 5.4 and 60 °C.

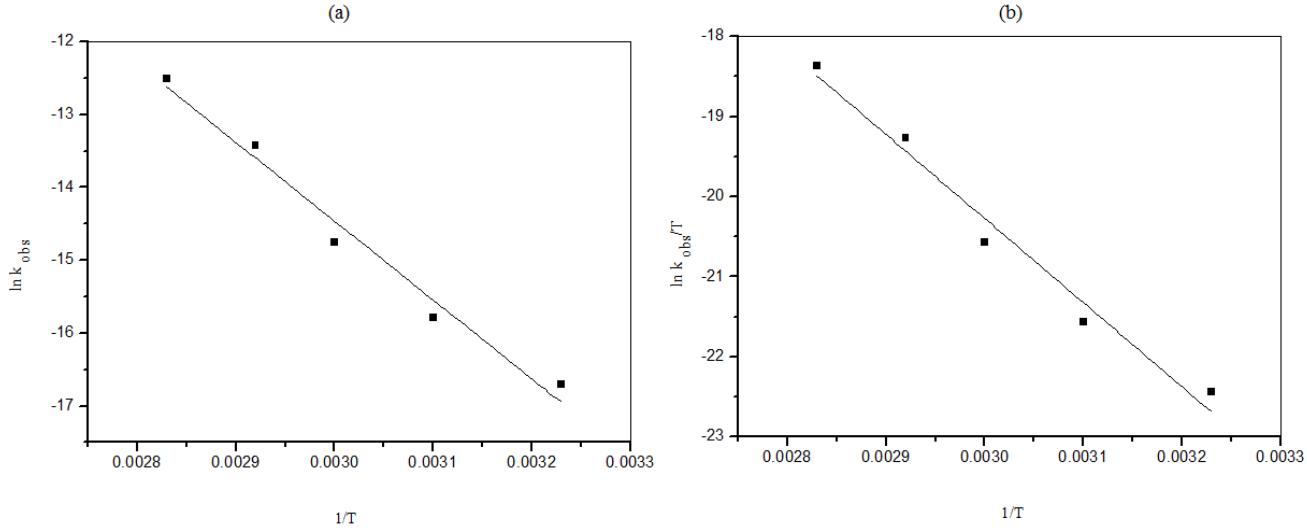

Figure S12. (a) Arrhenius plot of $\ln(k_{obs})$ as a function of 1/T and (b) Erying plot of $\ln(k_{obs}/T)$ as a function of 1/T for the cleavage of 2.0 mM Gly-Gly by **1** at pD 5.4.

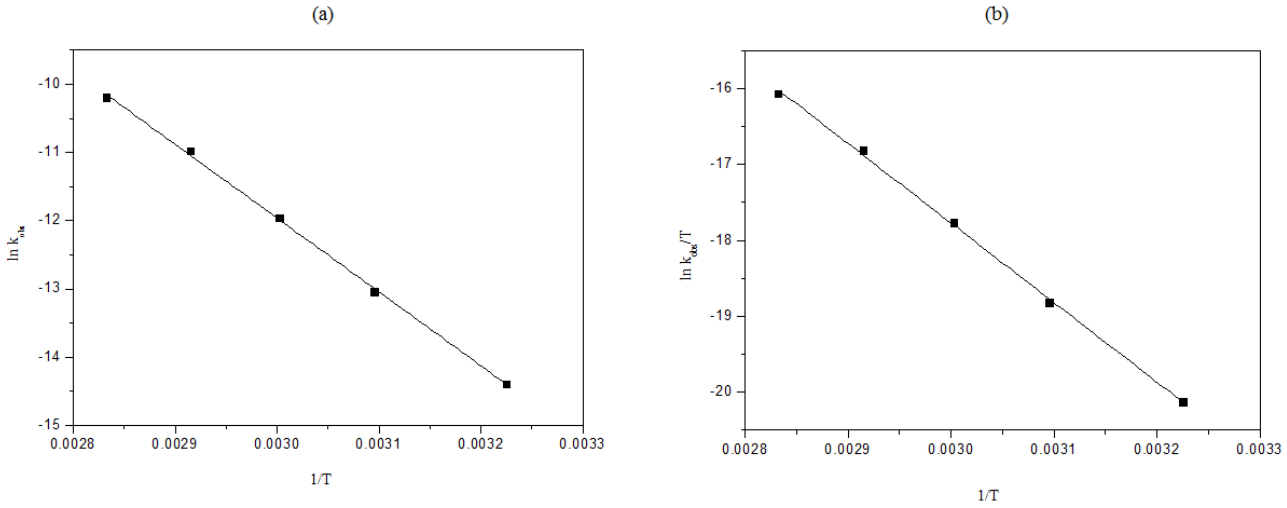

Figure S13. (a) Arrhenius plot of $\ln(k_{obs})$ as a function of 1/T and (b) Erying plot of $\ln(k_{obs}/T)$ as a function of 1/T for the cleavage of 2.0 mM Gly-Ser by **1** at pD 5.4.

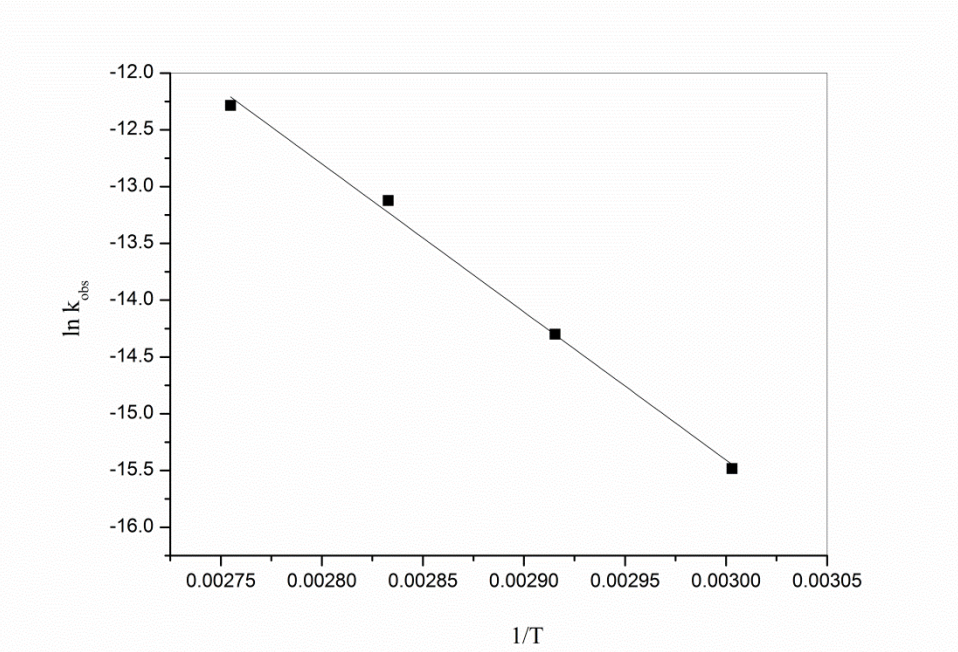

Figure S14. Arrhenius plot of ln(k_{obs}) as a function of 1/T for the cleavage of 2.0 mM Gly-Ser in the absence of **1** at pD 5.4.

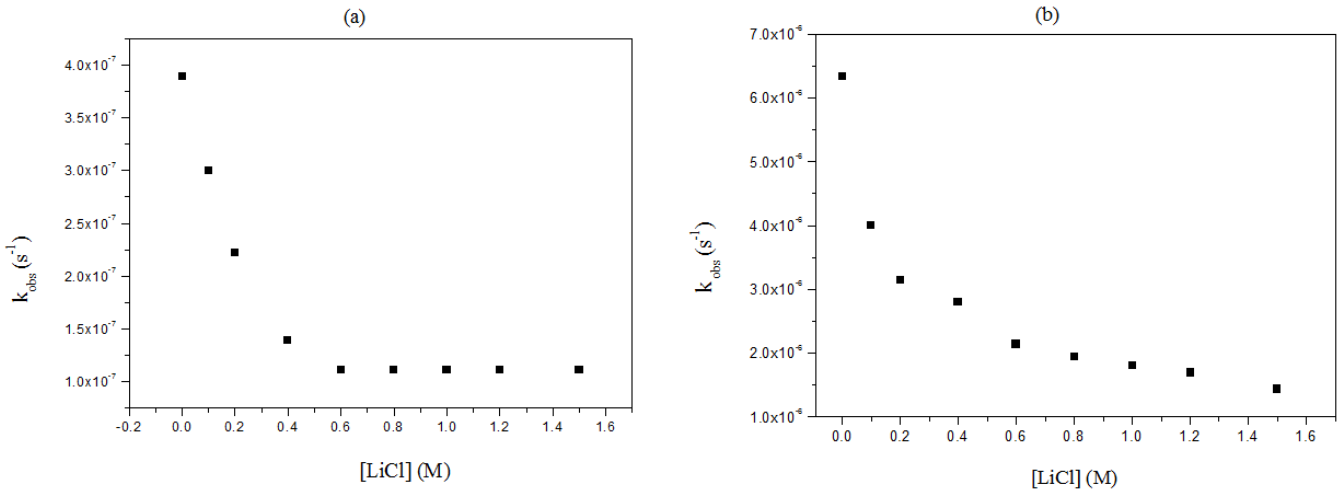

Figure S15. Salt effect on the rate constant of the hydrolysis of (a) 2.0 mM Gly-Gly and (b) 2.0 mM Gly-Ser in the presence of 2.0 mM **1** at pD 5.4 and 60 ^{o}C.

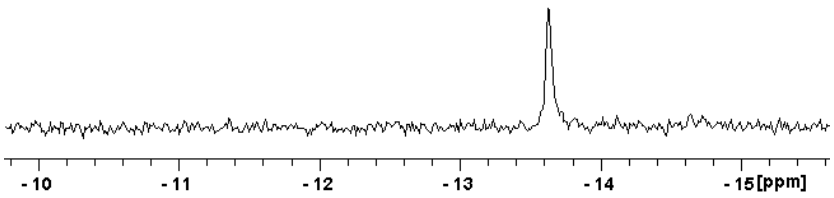

Figure S16. ^{31}P NMR spectrum of 2.0 mM **1** in the presence of 2.0 mM Gly-Ser and 1.0 M LiCl at pD 5.4 and 60 °C after 5 days.

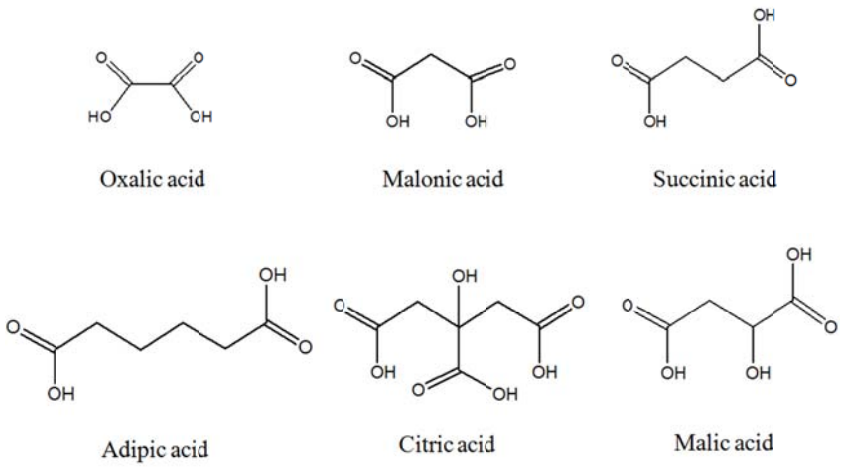

Figure S17. Chemical structures of the examined inhibitors.