

Table 1: Unit cell volume, composition, magnetic moment, and spin-angle from refinement of room temperature data (ilm35 was actually measured at 50 °C). The compositions were determined from the unit cell volume using Equation 1.

	$V(\text{\AA}^3)$	$x$	$(\mu_B)$	$M_{\perp}(\mu_B)$	$M_{\text{tot}}(\mu_B)$	$\alpha(^{\circ})$
<b>hem</b>	301.41 (3)	0	4.00 (3)	1.31 (4)	4.21 (2)	18.1 (6)
<b>ilm13</b>	303.69 (3)	0.176 (12)	3.98 (10)	0.80 (12)	4.06 (5)	11 (2)
<b>Ilm20</b>	304.05 (4)	0.207 (10)	3.81 (4)	1.21 (6)	4.00 (2)	17.6 (9)
<b>Ilm35</b>	305.62 (4)	0.341 (10)	3.24 (2)	1.36 (3)	3.51 (2)	22.7 (5)
<b>Ilm40</b>	306.18 (4)	0.387 (10)	3.45 (4)	1.17 (5)	3.64 (2)	18.7 (9)

Table 2: Néel temperatures determined from power law fit of  $M_{\text{tot}}$ .

	<b>hem</b>	<b>Ilm13</b>	<b>Ilm20</b>	<b>Ilm35</b>	<b>Ilm40</b>
$T_N$ (K)	948.8 (4)	799.9 (7)	760 (6)	676.3 (4)	606.4 (12)

Table 3: Fit parameters, hyperfine field ( $B_{\text{hf}}$ ), isomer shift ( $IS$ ), quadrupole shift ( $\epsilon$ ) and relative spectral area from sextet fit to room temperature Mössbauer data. The uncertainty on the fitted  $B_{\text{hf}}$  is approximately 0.02 T and the uncertainty on  $IS$  and  $\epsilon$  0.004 mm/s. The reason the spectral areas for hem and ilm35 does not sum to 100 % is the magnetite component in hem which takes up 10 % of the spectral area, and the central doublet in ilm35, which takes up a spectral area of 2.6%.

		Sextet 1	Sextet 2	Sextet 3	Sextet 4
hem	$B_{\text{hf}}$ (T)	51.50			
	$IS$ (mm/s)	0.370			
	$\epsilon$ (mm/s)	-0.094			
	Area (%)	90.0			
Ilm20	$B_{\text{hf}}$ (T)	50.23	48.96	47.45	44.61
	$IS$ (mm/s)	0.384	0.397	0.422	0.523
	$\epsilon$ (mm/s)	-0.105	-0.100	-0.078	-0.035
	Area (%)	32.2	27.1	18.9	21.8
Ilm35	$B_{\text{hf}}$ (T)	48.77	47.21	45.07	39.27
	$IS$ (mm/s)	0.393	0.400	0.449	0.642
	$\epsilon$ (mm/s)	-0.110	-0.098	-0.076	-0.021
	Area (%)	23.2	22.6	24.5	27.2
Ilm40	$B_{\text{hf}}$ (T)	48.14	46.45	43.77	37.23
	$IS$ (mm/s)	0.393	0.419	0.471	0.670
	$\epsilon$ (mm/s)	-0.108	-0.099	-0.077	-0.009
	Area (%)	15.2	24.2	26.8	33.7