

1 **Supplementary file for:**  
2 **Characterization of natural magnetite nanoparticles aggregates from the Peña**  
3 **Colorada iron ore deposit, Mexico: genetic inferences**

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17 Supplementary Table 1. Chemical composition and structural formula of the MNA  
 18 (intergranular mineral; Mt, magnetite; B, berthierine; quartz, Q; calcite, C; and feldspar, Fl).

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	<i>PCA - 1</i>	<i>PCA - 2</i>	<i>PCA - 3</i>
Fe <sub>2</sub> O <sub>3</sub>	62.299	62.310	61.580
FeO	27.987	27.994	27.664
TiO <sub>2</sub>	0.584	0.234	0.224
MnO	0.212	0.043	0.033
NiO	0.044	----	0.015
Cr <sub>2</sub> O <sub>3</sub>	-----	0.024	0.024
CoO	0.118	0.144	0.101
V <sub>2</sub> O <sub>3</sub>	0.163	0.160	0.156
MgO	0.297	0.037	0.088
CaO	0.005	0.018	0.199
SiO <sub>2</sub>	0.057	0.042	0.052
Al <sub>2</sub> O <sub>3</sub>	0.379	0.399	0.417
Na <sub>2</sub> O	0.065	0.102	-----
K <sub>2</sub> O	-----	0.014	-----
<b>Σ</b>	<i>92.210</i>	<i>91.512</i>	<i>90.553</i>
Fe <sub>+3</sub>	15.593	15.667	15.690
Fe <sub>+2</sub>	7.786	7.821	7.833
Ti	0.146	0.058	0.057
Mn	0.559	0.012	0.010
Ni	0.012	-----	0.004
Cr	-----	0.008	0.008
Co	0.032	0.038	0.026
V	0.043	0.044	0.041
Mg	0.139	0.018	0.045
Ca	0.018	0.006	0.071
Si	0.018	0.014	0.018
Al	0.099	0.157	0.167
Na	0.039	0.064	-----
K	-----	0.004	-----
<b>Σ</b>	<i>24.484</i>	<i>23.911</i>	<i>23.970</i>

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22 Supplementary Table 2. XRD analyses of MNA after annealing at 650 °C and 750 °C, and  
 23 650 °C (second run).

Mineral	Concentrated MNA	Annealed at 650°C	Annealed at 750°C	Annealed at 650°C (second round)
Magnetite	x	x		x
Maghemite		x	x	x
Hematite		x	x	x

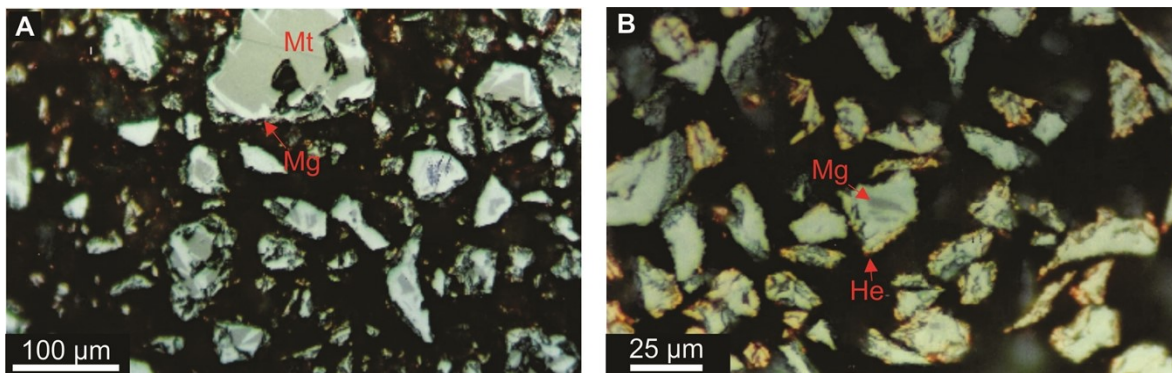
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25 Supplementary Table 3. Magnetic susceptibility vs. frequency measurements during  
 26 laboratory synthesis of magnetite nanoparticles after annealing at 650 °C, 750 °C and 650 °C  
 27 (second run).

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Sample	Magnetite nanoparticles	$\chi_{LF}$ 10 <sup>-6</sup> m <sup>3</sup> Kg <sup>-1</sup>	$\chi_{HF}$ 10 <sup>-6</sup> m <sup>3</sup> Kg <sup>-1</sup>	$\chi_{FD}$ 10 <sup>-6</sup> m <sup>3</sup> Kg <sup>-1</sup>	$\chi_{FD}\%$
PC7	~ 2-8 nm	3.31	2.88	0.43	13.0
PC7 650 °C	~ 2-8 nm	61.75	57.05	4.70	7.6
PC7 750 °C	~ 2-8 nm	46.91	43.86	3.05	6.5
PC7 650 °C (second heating)	~ 2-8 nm	11.20	10.45	0.75	6.7

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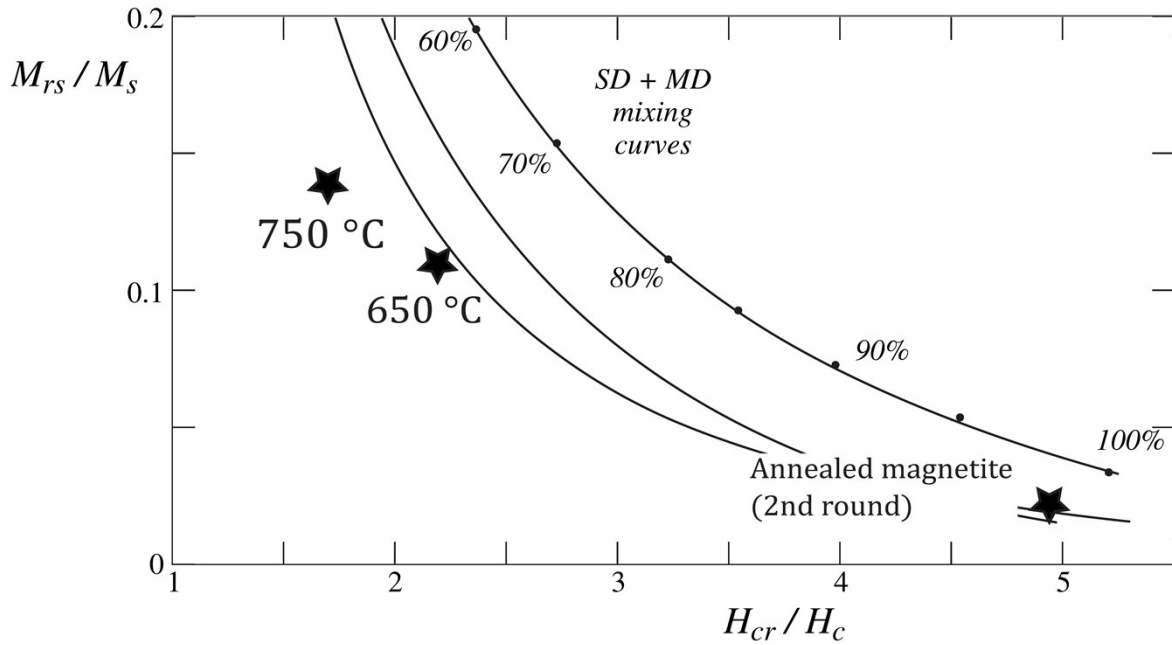


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32 Supplementary Figure 1. Reflected light images presenting (a) MNAs annealed at 360 °C  
 33 with a crust of maghemite (Mg) and magnetite (Mt) cores, and (b) MNAs annealed at 750 °C  
 34 with crust of hematite (He) and maghemite (Mg) cores.

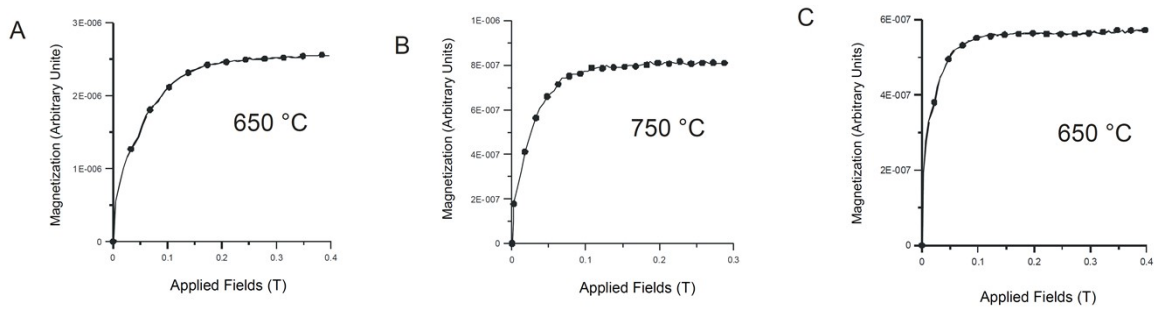
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37 Supplementary Figure 2. Hysteresis parameter ratio plot (coercivity,  $H_{cr}/H_c$  and  
 38 magnetization,  $M_r/M_s$ ) of berthierine concentrate sample after annealing (Day et al, 1977).

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41 Supplementary Figure 3. IRM results of berthierine concentrate samples after annealing.

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