ESRF	**Experiment title:** **Stability of the ferrimagnetic state in Cobalt-Iron ferrites under high pressure probed by XMCD**	**Experiment number**: HE 3202
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Names and affiliations of applicants (* indicates experimentalists):

Dra. Gloria Subías*, Dr. Joaquín García*, Sara Lafuerza*, Vera Cuartero*, Dr. Olivier Mathon [(1)], Dr. Sakura Pascarelli [(1)].

Instituto de Ciencia de Materiales de Aragón, CSIC – Univ. de Zaragoza, Zaragoza (Spain).

[(1)] ESRF, Grenoble (France).

Report:

We have performed a x-ray magnetic circular dichroism (XMCD) experiment under high pressure in order to investigate the stability of the ferrimagnetic ordered phase on $Co_xFe_{3-x}O_4$ (x=1, 1.5, 2) compounds. They are cubic spinels belonging to *Fd-3m* space group at room temperature, with a crystallographic configuration AB_2O_4, being A and B tetrahedral and octahedral sites, respectively. The cation distribution for $CoFe_2O_4$ is inverse type, where the majority of Co^{2+} is located at the B sites with the Fe^{3+}. As the Fe is diluted with Co, the cation distribution becomes more normal type, where Co^{3+} replaces Fe^{3+} on the octahedral sites [1].

Room temperature XMCD spectra have been collected, at the Fe K-edge (7.11 keV) in the case of x=1.5 and 2, and at the Co K-edge (7.7 keV) for x=1 in order to complete previous experiment [2]. We measured from atmospheric pressure (AP) to the maximum value of 30 GPa in case of $CoFe_2O_4$, applied to the powder samples using a non-magnetic cube Diamond-Anvil Cell equipped with a pair of 1.2 mm thick diamond anvils.

In previous experiments at the Fe K-edge, we observed that for $CoFe_2O_4$ the amplitude of the dichroic signal is almost constant when increasing pressure up to ~ 23 GPa and it sharply dissapears at 27 GPa [2,3]. The signal was not recovered back when releasing pressure, so that the transition is irreversible. Moreover, we could see on the absorption spectra that there were structural changes between the low and high pressure states, that were irreversible too. In this experiment, the evolution of the XMCD signal at the Fe K-edge with pressure of the x=1.5 and 2 samples can be seen in figure 1. Labels A and B correspond to E (A) =7108-7115 eV and E (B) =7120-7133 eV. For $Co_{1.5}Fe_{1.5}O_4$ we find that the dichroic signal decreases continuosly almost dissapearing at 16 GPa. When releasing pressure, it reaches half its initial value, approximately. On the other hand, the richest Co sample shows a totally reversible transition, evolving similarly to x=1.5 when decreasing pressure.

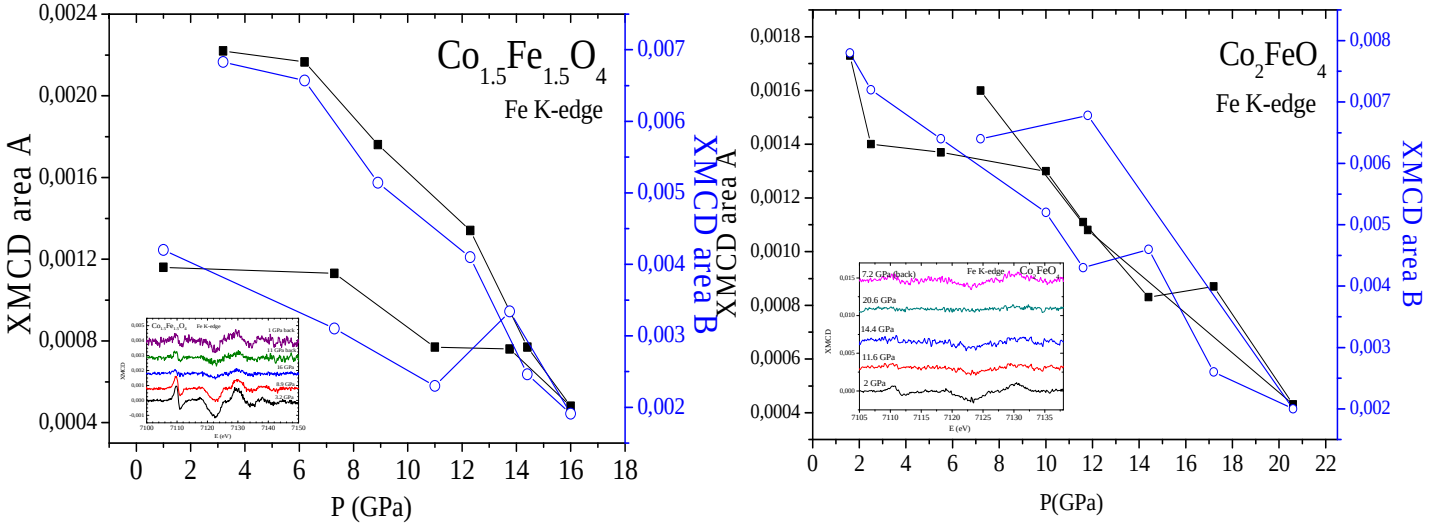

Figure 1. Integrated area of the XMCD peaks as a function of pressure for the Fe K-edge in $Co_{1.5}Fe_{1.5}O_4$ (left panel) and Co_2FeO_4 (right panel). **Inset**: XMCD signals when pressure is increased for $Co_{1.5}Fe_{1.5}O_4$ (left panel) and Co_2FeO_4 (right panel), artificially shifted in y-scale.

In Figure 2, we clearly see that the pressure-dependence of the XMCD signal for $CoFe_2O_4$ at the Co K edge is the same as the one previously found at the Fe K-edge. Indeed, the pressure-induced magnetic transition is irreversible too from the point of view of the Co magnetic moment.

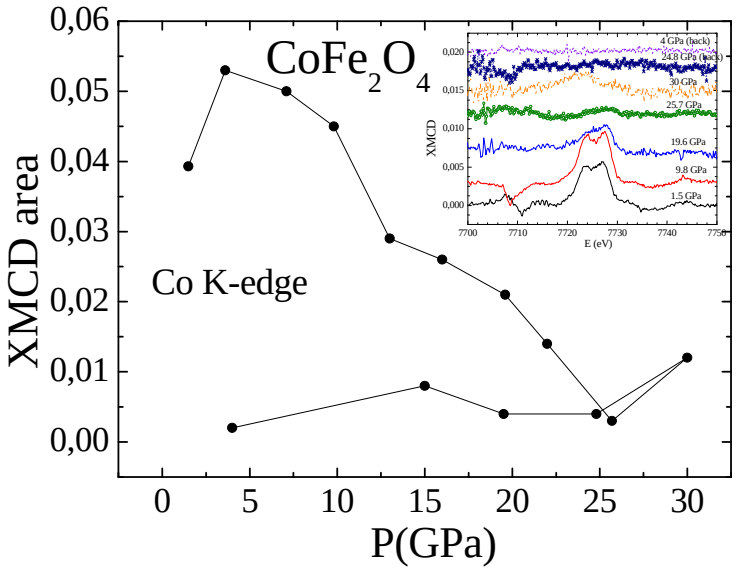

Figure 2. Integrated area of the XMCD peaks at diferent pressures. **Inset**: XMCD signals under pressure, artificially shifted in y-scale. Data are taken at the Co K-edge.

In conclusion, measurements in $Co_{1.5}Fe_{1.5}O_4$ and Co_2FeO_4 at the Fe K-edge show similar pressure-induced collapse of the ferrimagnetic ordering as the observed in $CoFe_2O_4$, being the transition pressure the lowest in the intermediate compound (x=1.5), ~16 GPa. The most surprising thing is the difference in the degree of reversibility of this magnetic transition depending on the Co content, being the transition in Co_2FeO_4 completely reversible. To determine the new magnetic and structural phase, we will pretend to perform x-ray diffraction and magnetic measurements at high pressures in further studies.

[1] N. Kita et al., J. Synch. Rad. 8, 446 (2001)
[2] See ESRF experimental report HE-2933
[3] G. Subías et al., J. Phys: Conf. Series 190, 012089 (2009)