Extra material to show the similarities between several specimen tested in similar conditions. The paper is showing the results of specimen Armco 12. The other specimens are presented below.

Figure 7a shows the fracture surface of specimen 12 after the final fracture. The fracture surface analysis of a ductile material's fracture surface shows characteristic features that define three zones. The first one is the initiation, from 0 to 181 or 252μm (depends on the side of the specimen); it is characterized by the grain trace appearance on the fracture surface and flat surface (Figure 7b) which origin is discussed below. They are related to the microstructure of the material. Then, the short crack is from 181/252 to 1409 μm. The short crack presents elongated shapes called ridges (Figure 7c). And then there is the long crack, from 1409 to 4000 μm, it's characterized by the presence of striations presented in Figure 7d. Striations appear at 1400 microns, and from around 1900 microns, a large quantity of striations is visible on the fracture surface. Each zone is presented in more detail later in this chapter. The observation of the fracture surface thus allows drawing the boundaries in red.

The same method of fracture surface analysis is done for the other samples studied in this manuscript and are presented in Figure S2. The red dotted curves delimit the transition from initiation to short crack and the solid line curves delimit the transition from short to long crack. The images of the fracture surface highlight the similarity between the samples.
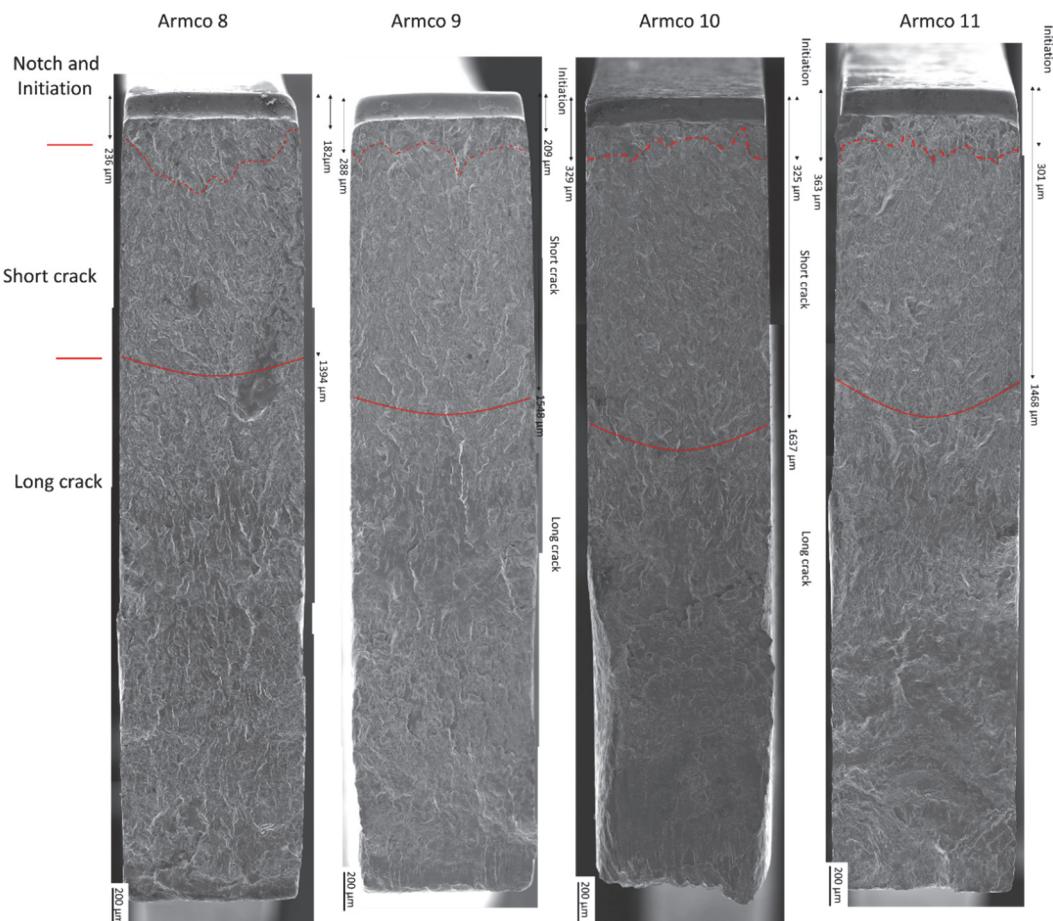

Figure S1. Fracture surface of sample Armco 8 to 11 with indication of three propagation stages.

An EBSD analysis was done before the tests to know the orientation of the grains on the surface near the notch. The following results show the path of the crack in order to identify if the propagation is intergranular or transgranular. In addition, the propagation speed from the optical camera allows to highlight the effect of the microstructure on the crack propagation. The images will be used to write another scientific paper, that's why there are numbers on the figures.
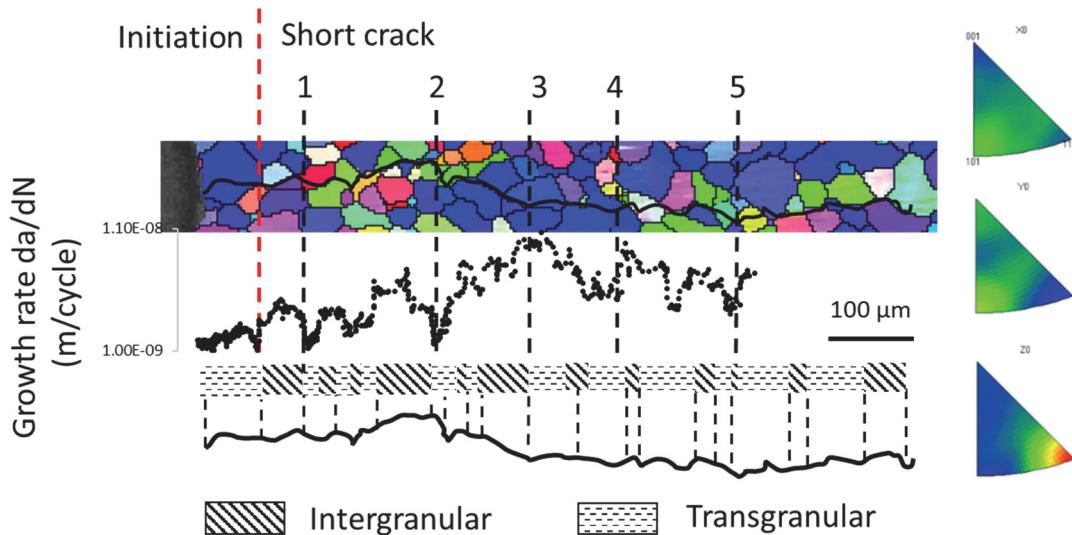

Figure S2. EBSD result together with crack path and growth rate of sample Armco 8.
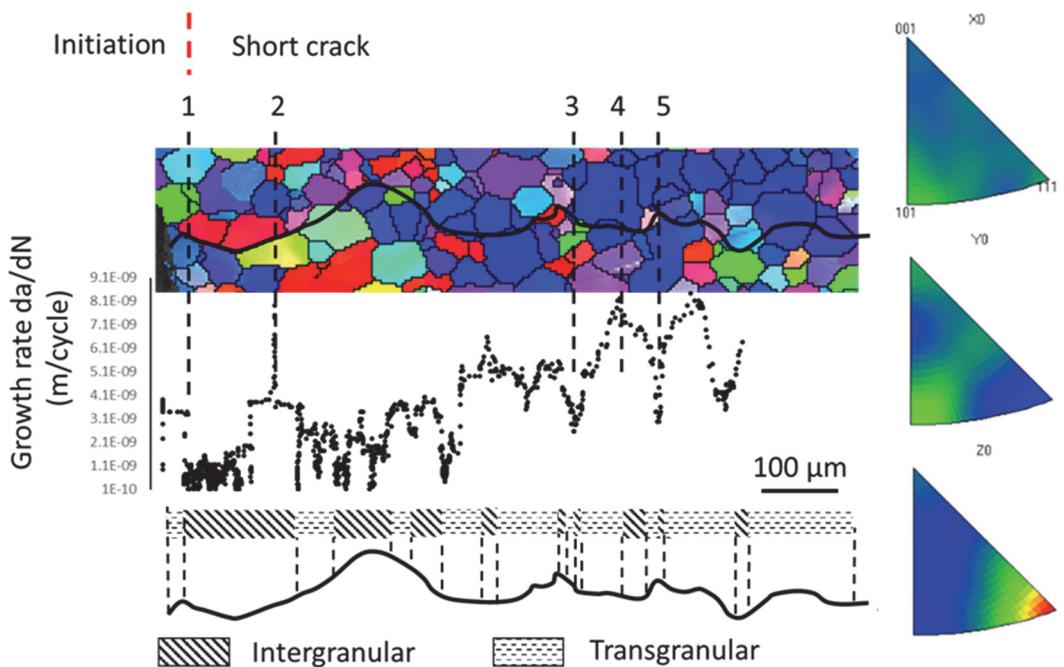
Figure S3. EBSD result together with crack path and growth rate of sample Armco 9.
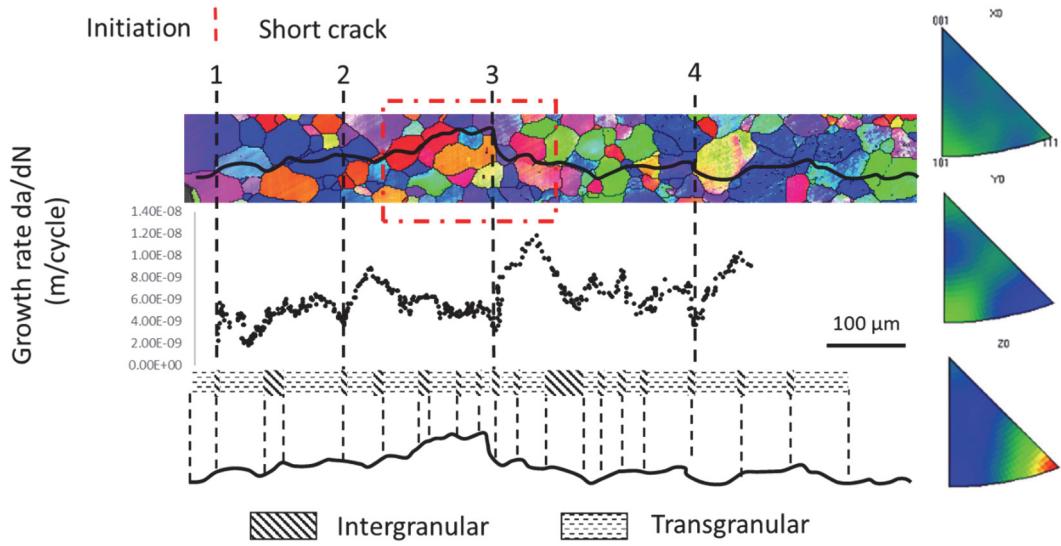
Figure S4. EBSD result together with crack path and growth rate of sample Armco 10.
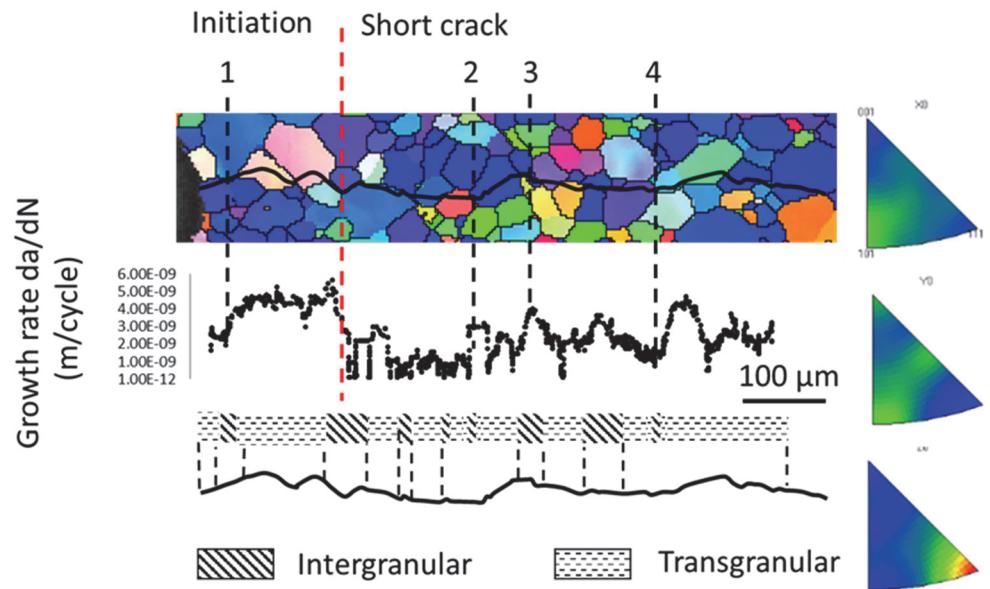
Figure S5. EBSD result together with crack path and growth rate of sample Armco 11.
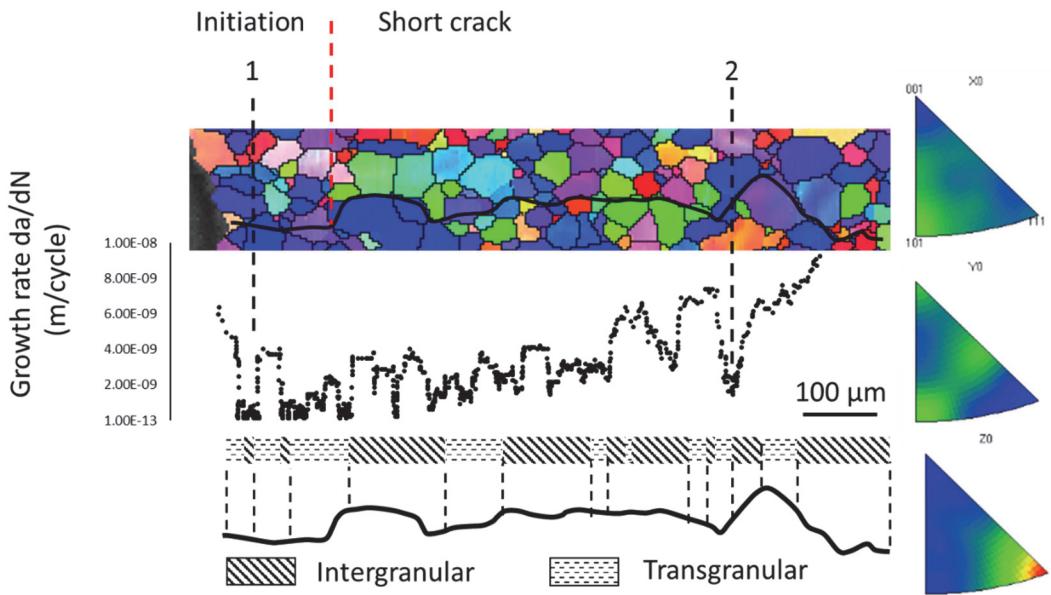
Figure S6. EBSD result together with crack path and growth rate of sample Armco 12.

Using the tools to calculate the fitting curve equation, it was possible to calculate the fitting curves for the tests and represent them in Figure S8.
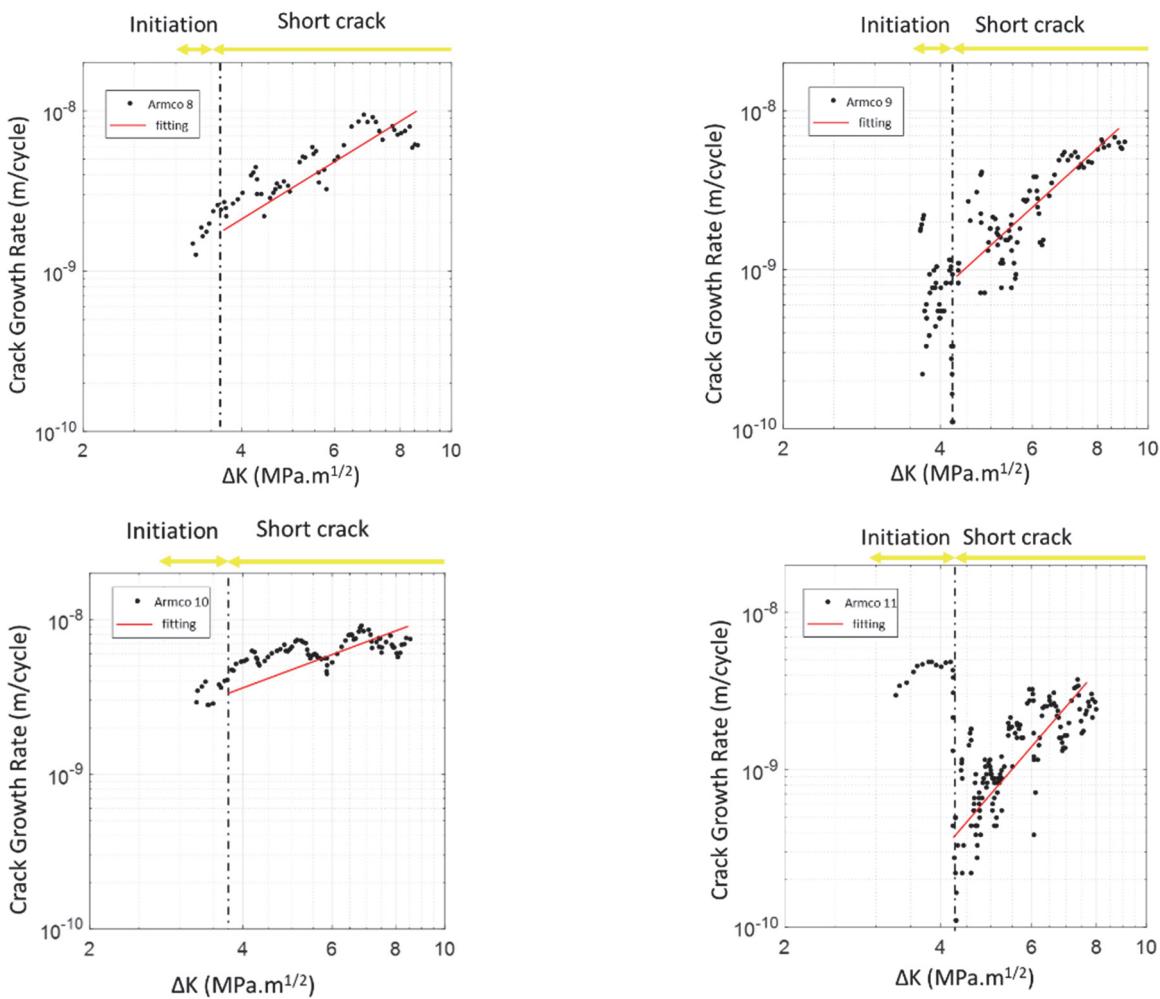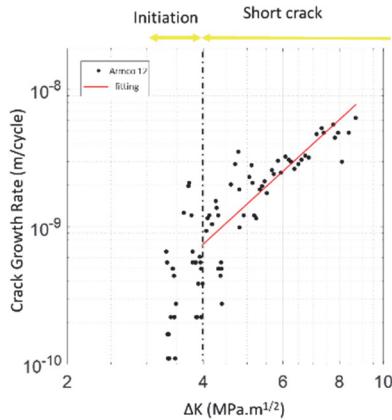
Figure S7. The crack growth rate versus the stress intensity factor for the 5 experiments.

The $\Delta K_{threshold}$ level measured in Figure S7 is listed in Table S1 for each specimen. The values correspond to the transition from initiation to short crack. The average value of the 5 results is 3.985 MPa.m$^{1/2}$. This value is in agreement with the results obtained in the literature for materials similar to Armco iron.

Table S1. Threshold of cyclic SIF at transition from short to long crack for the 5 specimens.

Sample No.	$\Delta K_{threshold}$ (MPa.m$^{1/2}$)
8	3.705
9	4.198
10	3.731
11	4.231
12	4.061

The power curves in red on the 5 graphs of Figure S8 are shown in Figure S9. Figure S9 shows the crack propagation speed as the Stress Intensity Factor function.
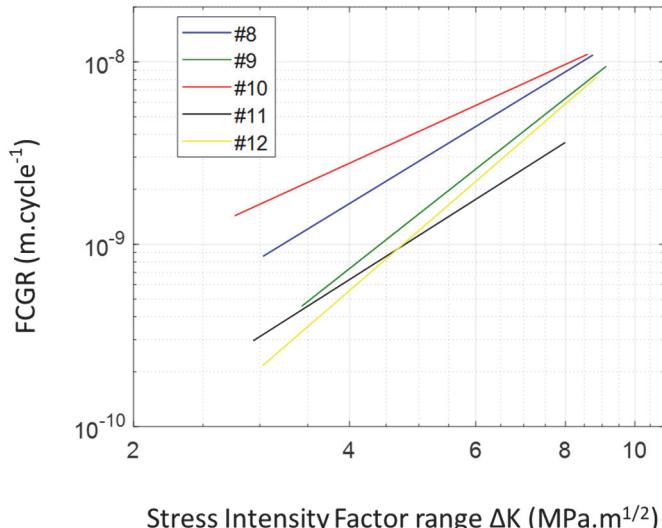

Figure S8. Comparing of crack growth rate by the trend curves on 5 samples.