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CO_2 corrosion of mild steel and how the precipitation of the corrosion products could affect the protectiveness of the underlying material have been extensively investigated during the last decades. In CO_2 corrosion condition, one almost always encounters the formation of corrosion scale including carbonates phases as well as several kinds of (hydro-) oxides. Initial microstructure of material could highly influence the mechanisms responsible for CO_2 corrosion as well as the resistance of the material against further deterioration. However, not many studies have been performed on understanding the influence of initial microstructure on corrosion behavior in CO_2 sweet conditions on a real scenario i.e. formation water chemistry with electrolytes containing Ca^{2+} ions.

The detailed investigations in this study are focused on understanding the effect of heat-treatment induced microstructural features on CO_2 corrosion behavior and scaling of the low-alloy steels. For this purpose, L80-1Cr material was subjected to several heat treatments (Heating to austenitizing temperature and then cooled in different medias) to obtain different initial microstructures. The heat-treated samples were then electrochemically exposed to CO_2 saturated simulated formation water chemistry. Electrochemical and corrosion behavior of the steels were evaluated using DC polarization and AC impedance techniques. Microstructure, surface chemistry, and surface morphology before and after corrosion experiments were investigated using Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD). Moreover, depth-resolved phase identification of the corrosion scales were applied using synchrotron X-ray diffraction to determine the sequence and extension of corrosion products across the depth.