In contrast to the well-studied North Sea chalks, the effectiveness of log-based specific surface area modeling techniques for heterogeneous Iranian (Middle Eastern) carbonates is underexplored. Petrographic analysis exhibits processes like dissolution, dolomitization, and anhydrite cementation that have significantly altered the Asmari Formation's fabric, leading to substantial pore struc ture heterogeneity. Results are compared with core data, including porosity, permeability, facies identified through thin-section petrography, mineralogy via X-ray diffraction, mercury injec tion porosimetry, and low-field nuclear magnetic resonance spectrometry. The first method utilizes density and gamma ray logs, as previously validated in North Sea chalks, while the second method innovatively integrates deep resistivity and porosity data using a K-nearest neighbor machine learning algorithm. Provided the fractures in the core samples truly represent fractures in the reservoir, permeability modeled using log-based specific surface tends to underestimate permeability, achieving a cor relation coefficient of 0.62 for the first method and an improved results (CC = 0.7) from the machine-learning approach