A Markov chain-based geostatistical model for three dimensional field predictions of the categorical attributes was developed, recently (Park, 2010). In the study, the developed model (ie. generalized coupled Markov chain, GCMC) was benchmarked with a conventional geostatistical model of sequential indicator simulation (SISIM). From the quantitative and qualitative analyses on the benchmarking results, it was concluded that the predictions from GCMC is superior to that from SISIM model, especially for the case where the input conditioning information is sparse. In the study, however, the superiority of GCMC prediction was drawn conditioning on a specific site. Multiple comparative studies, including the case of extreme non-stationarity, are required to further confirm the excellence of the GCMC model over the predictions made by conventional models. In this study, we apply both GCMC and SISIM model to multiple geologic maps which are ready-made and generally show directional non-stationarity. To mimic actual field sampling, we limit the number of conditioning data at random locations considering the size of domain. The generic measures introduced by Park (2010) are employed for the comparisons of the models. From the benchmarking cases, the GCMC model generally performs better in predicting lithologies at the correct locations and in predicting spatial structures. The better performance of the GCMC model is possibly attributed to the ability of handling directional non-stationarity which the counterpart does not have.