www.gondwanags.org.in
Research Article

ISSN : 2455-1953
JGSR
Journal of Geosciences Research
Vol. 11, No.1, January, 2026, pp. 33-42

Petrographic Characteristics and Dynamic Recrystallization of Four Quartzite Units of the Central Nepal, Lesser Himalaya

Dinesh Raj Sharma and Naresh Kazi Tamrakar*

Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal
(**Corresponding Author, E-mail: naresh.tamrakar@cdgl.tu.edu.np*)

Abstract

Petrographic investigations of quartzites from four distinct units Fagfog, Dunga, Pandrang, and Chisapani Quartzites within the Central Nepal Lesser Himalaya were undertaken to characterize composition, texture and microstructures. The Fagfog and Dunga Quartzite respectively belong to the Lower Nawakot Group and the Upper Nawakot Group, whereas the Pandrang and the Chisapani Quartzites belong to the Bhimphedi Group of the Kathmandu Complex, and occur in ascending order. The Kathmandu Complex (allochthonous sequence) thrusts over the Nawakot Complex (autochthonous sequence) along the Mahabharat Thrust. Microscopic techniques, including polarized light microscopy and point-count analysis were employed to reveal significant petrographic variations among the studied units. The Fagfog Quartzite, comprising 89-94% quartz with minor muscovite and biotite, exhibits a massive microstructure characterized by subequant to elongate grains and evidence of low-temperature deformation dominated by subgrain rotation, indicating a sedimentary protolith with minimal metamorphic overprint. The Dunga Quartzite, containing 85-93% quartz, displays both banded and massive textures with equigranular to porphyroclastic grains, reflecting mixed recrystallization mechanisms such as subgrain rotation and grain boundary migration that suggest moderate deformation. In contrast, the Pandrang Quartzite, with quartz content ranging from 83-95%, is characterized by polygonal grains indicative of high-temperature grain boundary migration, and whereas the Chisapani Quartzite, exhibiting 85-91% quartz, is marked by ribbon-like quartz fabrics formed under intense strain at high temperatures. These petrographic differences delineate an inverted metamorphic gradient, underscoring the region's complex tectonic evolution and providing insights into lithostratigraphic correlations and potential applications as ballast material for infrastructure development. This study not only delineates quartzite petrographic variations but also enhances understanding of the regional tectono-metamorphic framework. Analysis of microstructures and mineralogical data supports inferences regarding deformation-related microfabric development and prevailing metamorphic conditions, offering valuable insights for geological research and engineering applications

Keywords: Quartzite, Petrography, Deformation, Metamorphism, Lesser Himalaya

Introduction

Quartzite is a silica-rich, durable lithology formed through either the metamorphic recrystallization of quartzose sandstones or the diagenetic cementation of quartz grains in sedimentary environments (Passchier and Trouw, 2010; Trouw *et al.*, 2010). As a rock type, quartzite is primarily composed of quartz (SiO_2), which typically accounts for over 90% of its mineralogical composition, with minor amounts of feldspar, mica, and accessory minerals such as zircon, tourmaline, and rutile (Blatt and Tracy, 1996). The high quartz content imparts exceptional hardness and resistance to weathering, making quartzite a significant rock in both geological studies and engineering applications (Sharma and Tamrakar, 2023). Quartzites in nature are classified into two primary genetic types: sedimentary quartzite (orthoquartzite) and metamorphic quartzite (metaquartzite) (Dhital, 2015; Vernon, 2018). Orthoquartzite is a sedimentary rock formed by the silica cementation of well-sorted, rounded quartz grains, preserving primary sedimentary features such as cross-bedding and grain sorting (Blatt and Tracy, 1996). In contrast, metaquartzite forms through dynamic or thermal metamorphism, leading to the recrystallization of quartz grains and the development of granoblastic textures, sutured grain boundaries, and a more interlocking crystalline structure (Stipp *et al.*, 2002). These differences are crucial for interpreting provenance and tectonic histories, as sedimentary quartzites tend to fracture around quartz grains, while metamorphic quartzites display fractures that cut through grains due to their recrystallized nature (Vernon, 2018). A key process influencing metamorphic quartzite formation is dynamic recrystallization, which involves deformation-driven reorganization of quartz grains under metamorphic conditions (Stipp *et al.*, 2010; Law, 2014). This process occurs through three progressive mechanisms: bulging recrystallization (BLG) at temperatures of 250-400°C, subgrain rotation (SGR) between 400-500°C, and grain boundary migration (GBM) above 500°C, each contributing to the development of strain-free quartz grains and modifying the rock's microstructure (Stipp *et al.*, 2002). The study

(Received : 01 July 2025 ; Revised Form Accepted : 20 November 2025)
https://doi.org/10.56153/g19088-025-0268-93