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# Atlas of Shear Zone Structures in Meso-scale

 Springer

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*I dedicate this book in memory of  
my maternal grandfather late  
Mr. Ranendra Kumar Banerjee*

# Preface

Interpretation of structures from field is an integral part of structural geology. While research papers cannot display morphologic variations of individual structures, an atlas of field structural snaps remained due. This book fills up that gap. I have drawn most examples from western Himalayan shear zones. The reader is suggested to consult the key papers in the 'References' section for more information. I welcome comments and counterarguments at: [soumyajitm@gmail.com](mailto:soumyajitm@gmail.com)

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# Chapter 1

## Ductile Shear

Ductile shear can host economically important minerals (Upton and Crow 2013). S–C fabrics (Bèrthe et al. 1979; Mukherjee 2011; Figs. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19, 1.20, 1.21, 1.22, 1.23, 1.24, 1.25, 1.26, 1.27, 1.28, 1.29, 1.30 and 1.31) and sheared clasts (Passchier and Trouw 2005; Figs. 1.32, 1.33, 1.34, 1.35, 1.36, 1.37, 1.38, 1.39, 1.40, 1.41, 1.42, 1.43, 1.44, 1.45, 1.46, 1.47, 1.48, 1.49, 1.50) are the commonest ductile shear sense indicators in meso-scale. Sigmoid-shaped or sigma structures of clasts are most common (Figs. 1.32, 1.33, 1.34, 1.35, 1.36, 1.37, 1.38, 1.39, 1.40, 1.41, 1.42, 1.43, 1.44, 1.45, 1.46, 1.47). On the other hand, delta structures are rather rare (Fig. 1.50). Secondary ductile shears (Figs. 1.5, 1.12, 1.14, 1.15, 1.17) indicate a pure shear component, besides simple shear, within the shear zone (Goscombe et al. 2006). Presence of granitic melt/leucosome at both S- and C-planes indicate possibly a syn-shearing migmatization (Marchildon and Brown 2003; Misra et al. 2009; especially Figs. 1.3, 1.4, 1.5, 1.9, 1.14, 1.15, 1.17, 1.20, 1.23, 1.25). Unlike tectonic simple shear (Mukherjee 2012), magma flows can locally induce ductile shear. The most ubiquitous manifestation of this are sheared vesicles (Philpotts and Ague 2005; Misra 2013; etc.; Figs. 1.51, 1.52, 1.53, 1.54). For reviews on S–C fabrics, see structural geological text books such as Davis et al. (2012). In terms of tectonics, ductile shear fabrics from the Greater Himalayan Crystallines indicate a top-to-S/SW fore-shear, which has also been well documented also under microscale (e.g. Mukherjee 2013a). Additionally, from the South Tibetan Detachment, a top-to-N/NE extensional shear is also reported, which has recently been explained by a combination of crustal channel flow and critical taper mechanisms (Beaumont and Jamieson 2010; recent review by Mukherjee and Ghosh 2013).