INTRODUCTION

This study deals with active tectonic sedimentary basin formation related to mountain building processes in the deep interior of the Eurasian continent. Such intraplate tectonism differs in style and dynamics from plate boundary tectonism. The latter is controlled by strong deformation along narrow zones accommodating most of the plate motion, whereas intraplate continental deformation seems to be more homogeneously distributed over the lithospheric volume. Another complication in intraplate deformation is the highly heterogenous and anisotropic nature of continental crust. With the ongoing appearance of detailed studies, continental deformation reveals a generally strong and complex three-dimensional strain partitioning, with kinematics deviating from the classical regimes.

Sedimentary basin formation is one of the most important intraplate processes. Except for the economical importance, continental extension and basin development has a conceptual significance, as continental rifts are strongly related to continental breakup and oceanic basin formation. Continental basins occur in a wide variety of tectonic settings, from pure extensional to pure contractional. Spatial- and temporal relations between the driving forces and the resulting structures are divers, and descriptions of new settings and mechanisms are published regularly.

The interplay and relative importance of far-field horizontal stresses and regional vertical stresses is a controlling factor in both intraplate mountain growth and basin formation. Since the hypothesis was stated that active tectonics in Central Asia, from Tibet up to the Baikal rift zone, has been driven by forces originating from the India-Eurasia collision [Molnar and Tapponnier, 1975], much work has been done quantifying the regional kinematics and dynamics in magnitude, time and space.

The possibility of rift-basin formation without direct and primary control of the underlying asthenosphere is more and more accepted. Several studies suggest a first phase of passive rifting, controlled by far-field stresses, succeeded by asthenospheric controlled active rifting.

The role of pre-existing structures in the development of continental graben and rifts in many cases seems to be a controlling factor in the early basin architecture and structural evolution. In particular, their orientation with respect to the applied stresses and with respect to the surrounding (country rock) structures has an important influence on the evolution of the basins. Rheological heterogeneity of much of the continental lithosphere (induced by age-, composition- and anisotropy differences) complicates the distribution and characteristics of stress and deformation.

The mechanism of the initiation of continental rifts is directly related to these specific controlling factors. Most basin evolution models propose that the extensional faulting initiates- or occurs early in the evolution of continental graben. The geometry of the basin at that stage is controlled by the geometry of the extensional faults and transfer components (accommodation zones). In the subsequent phases of basin formation, modification by erosion of parts of the tilted listric fans and sedimentation in back-rotated fault blocks cause considerable problems in identifying and mapping the early geometry of the graben, and thus in verifying the hypotheses.

In this sense, the study of the structural characteristics and kinematics of a very young continental basin offers a unique opportunity to unravel the first and youngest stage of the evolution of a continental graben.

The present study aims at contributing to the understanding of the early structural evolution of continental basins, in relation with the surrounding structures, kinematics and dynamic settings. This is done by studying a specific region of graben formation in a young and active tectonic context.

The Central Asian Deformation Zone is an excellent region to study the origin and evolution of continental sedimentary basins in general, and of extensional graben in specific. It is composed of a mosaic structure of heterogeneous blocks, deforming in a highly partitioned way. Specifically the Altai-Sayan zone in the northern part of the Central Asian deformation zone displays the development of extensional graben of very young age, related to transpressional mountain building processes. From these young graben, the Teletsk basin in Altai is the most prominent, and therefore it is studied in detail in the frame of the present study.

This study deals with the kinematic and dynamic aspects of active brittle tectonics related to this graben formation. For this, it aims to assess the upper crustal deformation directly observed at the surface. The main questions addressed are:

- What is the appropriate methodology for determining active and recent faulting in heterogeneous basement terrains in the absence of widely developed stratigraphic time marker beds? How are these faults structurally expressed, and how can we assess their timing and their relationships (mutual influences)?

- How did the studied region structurally develop in the current tectonic regime? In other words, how can we explain and relate the observed actively forming contractional-, wrench- and extensional structures in Altai-Sayan?

To answer these questions, the following approaches are critically analysed:

- The morphological aspects of relief elements studied by remote sensing at various scales, and their relations with deformation.

- The sub-surface aspects of the deformation, assessed by geophysical data: high resolution seismic profiles and radon-gas geochemical profiles.

- Micro-structural analysis of fault movements, assessing fault kinematics and local dynamic aspects.

After an introductory chapter putting the study area in its general geodynamic context and addressing the main unsolved questions concerning its evolution, a critical review of the applied methods will provide an overview of the use and limits for applying them to the concrete problems addressed in this study. How can we assess active faults in mountainous basement terrains? If we recognise them, how do they move (kinematics) and what are the controlling factors (dynamics)? How does the deformation evolve and what is the result of the fault movements and fault interactions (tectonics)?

A second part of the work describes and discusses the kinematic and dynamic inferences made in the study area. It presents the results of a detailed investigation of the lake Teletskoye basin in Altai. It presents a model for the basin formation, and inferences concerning the early structural settings and evolution of this tectonic basin. Comparisons to other basins are made, and generalities are discussed. This part also discusses the active tectonics in the surrounding regions (Altai-Tuva-Sayan), related to the formation of sedimentary basins, including the Teletsk basin formation.

A last chapter summarizes the main results and conclusions concerning the recent geodynamic evolution of the area, the mechanisms of basin formation and the methodology for assessing information of active upper crustal deformation in basement mountainous terrains.