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CHAPTER 7

FIELD AND GPR STUDIES ALONG SOUTH WAGAD FAULT (SWF)

The Wagad Highland is the second largest uplift of the Kachchh basin after the mainland uplift. It occurs to the east of the Banni basin separating it from the depression of the Little Rann of Kachchh. It is surrounded by the Rav Basin to the north and to the east and south by the residual depression of the Little Rann of Kachchh (Fig. 7.1). The Rav Basin separates it from the Bela uplift. Only a narrow stretch of Little Rann which is a very shallow depression separates it from the Radhanpur-Bamer Arch. The uplift is thus close to the marginal High of the Kachchh Basin towards the east.

![Geological map of Wagad region](image)

**Figure 7.1** Geological map of Wagad region (after Biswas, 1993)

Structurally, the Wagad is a large oval uplift with a central dome and a highly faulted southern part (Fig. 7.1). Unlike the other uplifts which are bounded by one marginal fault accompanied by a flexure, this uplift is not bounded by a single fault or a
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marginal monocline. Several concentric, mutually converging, peripheral faults, each accompanied by a flexure parallel to it, present a complicated structural pattern of its southern part which has been uplifted with a northerly tilt. The northern part has been down thrown against the Gedi Fault which separates it from the Bela uplift. This northerly tilt has given rise to the structural low of the Rav Basin. The northerly tilt of Wagad is just opposite of the southerly tilt of the other uplifts. Each individual fault block is similarly oriented giving rise to a series of steps to the north with folds bordering the faulted up edges. Even the smallest fault is accompanied by a fold. All these faults are shattered in the southern half of the uplift and are collectively called as the South Wagad Fault System. The crestal part of the uplift has its own peculiarity. The central Wagad Hills represent the highest elevated part of the domal uplifts bounded by faults. Complementary structural lows are lacking, the domes are juxtaposed by faults. Thus the Wagad uplift is mainly divided into three zones – The Northern Zone, The central Zone and The Southern Zone.

Along the southern margin of Wagad occurs a long narrow hill range running from Mae village in the West, through Adhoi, to Gaun at the eastern tip of the area. This southern marginal range is broken at places by valleys and lowlands to form separate hills, e.g. Wamka Hill, Adhoi Hill, Chitrod Hill, Mewasa Hill, Gagodar Hill and Kanmer-Gon Ridge, form west to east. Further east in the Little Rann, the narrow east-west ridge of Mardak Bet is the eastward extension of this southern range of Wagad. Chitrod Hill shows the highest elevation in this entire range.

THE SOUTH WAGAD FAULT

A complex of idiomorphic folds, mainly domes and brachy anticlines, occurs on the southern part of the Wagad uplift, associated with a system of coalescing and ramifying faults. Several wedges, blocks, horses and troughs have been formed by the intersecting faults within the system (Biswa, 1993). Each of them is featured by a number of folds. The folds are elongated parallel or sub-parallel to the local strike of the accompanying fault. The folds are lined up along a fault on its up throw side even though individually they are variously oriented.

The faults of this zone together comprise the South Wagad Fault system (Fig. 7.1). The fault system consists of peripheral faults having sinuous trends (Biswa, 1993). Though many faults have been described by local names, in general they are parts of two continuous faults which describe broad concentric arcs on the map. The inner arc is represented by Kanthkot, Kharol, Dedarwa and Jadawas faults from the west to the east.
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(Biswas, 1993). The outer arc of faulting which defines the southern margin of the Wagad uplift, is represented by Adhoi and Khanpar faults. In the central and eastern part of this structural zone, both arcs of faulting converge and bifurcate at different points to give rise to wedge shaped fault blocks. They meet near Wastawa in the middle Wamka in the south-western Wagad and the other between Wastawa and Chitrod in the southern central Wagad. The Chitrod Fault wedge is divided again by a cross fault which bifurcates from the Kanthkot fault of the inner arc near Ghanodia and joins the Khanpar fault of the outer arc with an arcuate trend. This part which is bounded by the Khanpar and Kanthkot faults and Ghanodia cross- fault can be referred to as Wastawa-Ghanodia fault-wedge (Biswas, 1993). The part, to the east of the cross fault, may be referred to as the Chitrod fault block. To the east of Mewasa the two arcs converge finally and only the inner arc continues eastward as Dedarwa fault till it meets the Kidyanagar cross fault. It continues beyond the Kidyanagar fault after being off-set by the latter and finally dies off in the Ghanithal low (Biswas, 1993). This part of the fault has been named as the Jadawas fault. Besides these another semicircular fault block occurs to the east of the Wastawa dome. It seems to be a horse of the Kanthkot fault. The sense of movement along all the faults of the South Wagad Fault (SWF) system is the same. Both the peripheral faults have upthrow in the north like pair of step faults. The folds have been produced on the edges of the steps as is the general rule of the region.

A series of small domes and anticlines are seen along the two semi-concentric peripheral faults described above. The folds are closures within the fault flexures like the folds in the flexure zones of the Mainland uplift but they are much narrower and smaller in size, being restricted within one mile wide zones of folding along the bounding faults. Two long flexure zones along the two mutually converging peripheral faults are the main features of this structural zone. The Kanthkot-Dedarwa flexure zone occurs along the inner fault and the Adhoi-Chitrod flexure zone along the outer or marginal fault (Biswas, 1993). As the faults converge and bifurcates the two flexure zones also tend to coalesce and branch off. This has given rise to the intricate fold pattern and peculiar irregular outline to the intervening low. It may be mentioned here that these flexures, like all other flexures, are fault flexures and the flexures and faults mutually replace each other through the continuity of the faults.

The Kharol fault occurs to the northwestern margin of the Chitrod dome. Kharol fault strikes NE-SW with 70° dip towards northwest. This fault separates the Chitrod and Wastawa uplifts. Dedarwa fault starts from south of Dedarwa where the Kharol fault ends
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and it marks the northern margin of the Chitrod block and to the northeast of the Mewasa it becomes a marginal fault of the Wagad uplift (Biswas, 1993). It is typically an upthrust with steep marginal flexure along the edge of the upthrown block. Vekra fault occurs to the north of the Kanmer fault and trends parallel to it. The strike of this fault is E-W but takes swing to the WNW in the western extremity.

GEOMORPHOLOGY AND QUATERNARY SEDIMENTS

The geomorphic set up of the SWF zone is marked by a comparatively subdued south facing scarp (Fig. 7.2) and, a prominent southward slope developed over the Quaternary sediments in front of the scarps that further merges with the Samakhiali-Lakadia plain. In general, the tectono-geomorphic set up of the SWF zone is a miniaturized version of the KMF zone explained earlier. The south facing scarp is formed over the south facing Mesozoic rocks comprising the steeper southern limbs of the domes that make up the flexure zone on the northern upthrown side of the fault (Biswas, 1993). The scarp is dissected by the streams which originate from the southern limbs and also by streams that flow along the inter-domal saddles and originate on the northern sides of the flexure zone. As mentioned, the scarps show a subdued geomorphic expression. This is mainly because of the Quaternary sediments which show maximum thickness of 8-10 m that overlap the SWF zone and abut against the scarp faces.

![Figure 7.2 DEM of the SWF zone showing the sharp physiographic contrast along the fault. The sites of GPR survey are also shown.](image)

The Quaternary sediments occurring in the SWF zone (Fig. 7.3) consists of mainly miliolites and sandy to gravelly alluvial sediments. All miliolites deposits occurring in the SWF zone are of aeolian origin. The aeolian nature of the deposits is easily recognized owing to the uniform grain size and the prominent south sloping surface developed over them. They show typical morphology of obstacle dunes. The deposition of aeolian miliolites correlates with the rather prolonged regional phase of miliolite deposition documented from various places including the fault zones in Kachchh (Baskaran et al.
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1989; Patidar et al. 2007; Chowksey et al. 2011b). However, the deposition of aeolian miliolites is much more extensive in the SWF in comparison to the KHF and KMF zones where they occur in patches. In the SWF zone, the 8-10 m thick obstacle dunes of miliolites are found to continuously occur in front of the scarps from Mae in the west to Chitrod in the east.

![Images](image_url)

**Figure 7.3 (a)** North facing view of the surface developed over the Quaternary sediments in the SWF zone to the east of Adhoi. The low ridge at the far end marks the SWF scarp which exposes steeply dipping Mesozoic rocks. **(b)** View of the SWF zone near Adhoi village showing the Tertiary rocks overlain by Quaternary sediments as exposed in a pit in the foreground. The prominent surface abuts upslope with the SWF scarp seen as a low ridge at the far end. **(c)** Upstream view of Adhoi river showing semi-compacted aeolian miliolite exposed in the river bed. **(d)** Upstream view of the incised channel of Kara Vokra river near Halra village in SWF zone exposing Quaternary alluvial deposits. The linear ridge at the far end marks the SWF scarp.

The more extensive deposition of aeolian miliolites in the SWF zone is possibly because of the south facing nature of the scarps which provided the most effective obstruction and site for the miliolite sediments brought by the winds blowing from the south. In contrast, the KHF and the KMF scarps are north facing and therefore received much less aeolian miliolite sediments. The dunal nature of the miliolites appears to have almost overwhelmed the rugged topography and the fault scarps of the SWF zone (Fig.
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7.3a, b, c, d). Due to this, the SWF is almost completely buried below the miliolite and alluvial sandy deposits up to the eastern margin of the Chitrod dome near Khanpar. Further east the SWF is exposed in small patches along the incised south flowing streams (Fig. 7.4a, b). The fault is also expressed on the surface as vertical sheared Mesozoic rocks that mark the fault zone (Fig. 7.4c). Prominent knickpoints are also developed along the courses of small streams as they flow across the SWF zone (Fig. 7.4d, e).

Figure 7.4 (a) Exposure of the SWF along a stream at the SE margin of the Chitrod dome. Note the almost vertical sheared Mesozoic rocks and the Tertiary rocks exposed in the cliff section on the downstream side. (b) Southward view of the dissected topography. The SWF is seen in the foreground. (c) Vertical sheared Mesozoic rocks marking the SWF zone. Wamka village is seen in the background. (d) Upstream view of the knick point formed along the SWF by a small south flowing stream near Shivlakha (e) Narrow chasm carved out by the stream across the knick point shown in d.
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The miliolites at places are overlain by unconsolidated alluvial sediments. These sediments are seen in several incised sections of the streams that cut through the SWF zone. Prominent sections exposing the alluvial sediments are observed along the Mae stream and the Kara Vokra river cutting through the southern part of the Halra dome (Fig. 7.3d). The alluvial sediments comprise mostly sands with layers of stratified to massive stream gravels. The alluvial sediments are also found to abut against the scarps comprising Mesozoic rocks.

The drainages arise from the hilly terrain of the South Wagad hills (Fig. 7.5). The Kanthkot hills, Kharoi ridge, Adhoi anticline, various domes such as Mae, Wamka, Halra strongly controls the drainage pattern in the region. The low lying areas such as Gamdau valley, Samakhiali-Lakadia plains also plays significant role in the drainage development in the region. The overall drainage pattern shows a remarkable correspondence with the lows and highs of the South Wagad Flexure zone suggesting a strong structural control.

![Figure 7.5 Drainage map of the SWF zone.](image)

The major stream flow direction is southward and majority of them debouch into the Gulf of Kachchh. The radial drainage pattern is observed along the domal structures of the region such as Mae, Wamka, Halra etc. To the north of these domes the Chang River flows between two major east-west trending highlands, namely Kanthkot flexure zone to the northern and Southern flexure zone to southern side. The river flows through roughly ESE-WSW and E-W trending highlands which are structurally complex zones. Most of the streams form 2-8 m deep and narrow incised channels in the SWF and broad branching channels in the Samakhiali-Lakadia plain. The drainages in these plains show several drainage anomalies which are described in the next chapter. The drainages arising from the Mae dome take westward swing to meet the westward flowing Khari Vokra river in the Samakhiali-Lakadia plain. The southern limb of the Adhoi anticline shows several parallel streams which abruptly disappear in the Samakhiali-Lakadia plain.
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GPR DATA ACQUISITION

The principle and methodology used during the acquisition of the GPR data are explained in details in the Appendix. The importance of GPR studies in active fault zones and interpretation of faults in GPR data is described in Part-A. The main purpose of the GPR surveys in the SWF zone was to identify the near surface trace and delineate the shallow subsurface nature of the SWF. The profiles during the present study were collected by both shielded (monostatic) and unshielded (bistatic) antennas. The shielded antenna used during the present study comprises of a monostatic antenna with a central frequency of 200 MHz on the other hand unshielded antennas used during the present study had a central frequency of 40 and 80 MHz. Data was acquired in a continuous mode by using a monostatic antenna while point mode method of acquisition was used for bistatic antennas. Profiles were recorded in a laptop computer which is connected to the main unit. Initial several profiles were acquired to set the desired parameters. The time window of 140-150 ns was found sufficient to serve the purpose of our study while using 200 MHz monostatic antenna. And for bistatic antenna a time window of 250 ns for 80 MHz antenna and a time window of 500 ns for 40 MHz antenna were used. Auto gain with 5 was used during acquisition. It is followed by post acquisition processing of raw data which includes the distance normalization, noise filtering, surface correction followed by gain. The multiple offset profiles were collected at several sites in order to calculate the precise depth of our investigation. Common Mid Point (CMP) analysis was used to calculate the velocity of wave during its propagation in the ground which helps in calculating the dielectric constant of the ground. Velocity of 0.12 m/ns was calculated from the CMP analysis which is used for time-depth conversion.

Velocity Analysis

The velocity analysis was carried out by using MLF antennas at several locations. This type of analysis generally helps in determining the depth of investigation. The detailed methodology used is described in the Appendix part. The obtained value of velocity from the survey was then applied on each profile to calculate the precise depth of subsurface anomalies. Velocity profiles were collected at different locations in order to calculate the average velocity. The representative profile is shown in Fig. 7.6 which is acquired by 80 MHz bistatic antenna near Mewasa. The initial separation between the two antennas was 1.25 m and a step size of 0.25 m was used. The velocity analysis was carried out with the help of RADAN software which computes the velocity by plotting the multi offset data on graph of velocity verses two way zero offset travel time. The
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value of the velocity was later used to calculate the dielectric constant by using the formula given in the Appendix. Average velocity obtained from the velocity analysis is 0.12 which gives a relative dielectric permittivity of 5.76.

**Figure 7.6 (a)** Processed CMP profile recorded near Mewasa **(b)** Velocity diagram of the CMP profile shown in (a).

Near surface trace of SWF

The structural set up and neotectonic setting of the SWF is given at the beginning of this chapter. The fault is exposed in patches in the eastern part while in the western and central parts it is buried under a thick apron of Quaternary sediments (Fig. 7.4a, b). Field observations were made during traverses along the south flowing streams to narrow down the fault zone based on the rocks and sediments exposed in the cliff sections. However, since the fault zone is almost completely buried, the interpretation of GPR data was based on the nature of SWF as exposed in the eastern part. It was found that the SWF marked a faulted lithotectonic contact between the Mesozoic rocks to the north and the Tertiary (Neogene) rocks to the south (Fig. 7.4a, b). The Mesozoic rocks assumed vertical to steep southward dips in the fault zone. The setting was found to be similar to the KMF with reversed directions of down throw. The Mesozoic rock are compacted sandstone mostly belonging to the Wagad Formation while the Tertiary rock consist of Chhasra Formation and are softer in nature as they are dominated by clays. The Tertiary rocks show steep to vertical dips near the fault zone while they are almost horizontal in the Samakhiali-Lakadia plain in the south.
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GPR studies

The GPR surveys were concentrated in the central and western part where the fault zone of the SWF is buried under thick Quaternary miliolite and alluvial deposits. The GPR profiles included here were acquired at seven sites. All sites were selected after intensive field studies. The interpretations are based on the observations made during the field studies.

Site I

This site is located to the east of Wamka village at the southern fringe of the Wamka dome (Fig. 7.2). The site is located close to a stream that dissects the central part of the dome and flows southward. The site was selected as the possible fault zone of the SWF based on the small outcrops of the steeply dipping Mesozoic rocks jutting out of the gently undulating ground. Several N-S profiles were acquired across the general E-W trend of the fault. The best of the profile after the processing were considered for interpretation (Fig. 7.7a). The profile was taken with the help of 200 MHz monostatic antenna in a continuous mode.

![GPR profile](image)

**Figure 7.7 (a)** GPR profile obtained from east of Wamka village with 200 MHz antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. **(b)** Oscilloscope of a single scan emanating from of the Mesozoic rocks **(c)** Oscilloscope of a single scan emanating from of the Tertiary rocks. **(d)** The boxed portion of (a) is shown in a Wiggle mode.

The profile shown is a 17 m part of a long GPR profile. The top portion of the profile is characterized by high amplitude continuous to wavy reflection which denotes the Quaternary sediments deposited by the nearby channel. The thickness of the Quaternary sediments is found to increase southward and it attains a thickness of around ~4m at the southern margin of the profile. The Quaternary sediments are easily
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distinguishable with the underlying radar reflections. A distinguishable radar reflection is seen at the base of Quaternary sediments. The basement is characterized by high amplitude, broader radar reflection and low amplitude radar reflections which are thin and chaotic. The variation in the amplitude of high amplitude and low amplitude reflection is clear from the amplitude traces (Fig. 7.7b and c). Based on the field setting of the SWF zone, the high amplitude radar reflection are interpreted as indicating the compacted Mesozoic rocks in which the high amplitude reflection is on account of less energy loss during its propagation while the low amplitude reflection is on account of the clayey rich Tertiary rock which acts as a highly conductive medium resulting in the attenuation of the energy during transmission. The truncation of the two distinct radar reflections is seen at a distance of ~9m which characterizes the faulted contact of Mesozoic and Tertiary rocks (Fig. 7.5a and d). The South Wagad Fault (SWF) from the profile can be characterized as a south dipping near vertical reverse fault.

Site II

This site is located at the southern margin of the Halra dome at about 2 kms east of Halra village (Fig. 7.2). The southern limb of the Halra dome is steep and forms prominent geomorphic expression of the SWF in the form of south facing scarps. Several N-S profiles were acquired with the help of 40 MHz bistatic antenna (Fig. 7.8). The separation between the two antenna during the acquisition were kept 2.25 m with a step size of 25 cms.

The top portion in the profile in the central part of the profile is characterized by a thin continuous horizontal reflectors which is on account of scree material generally deposits over slope (Fig. 7.8a). Below it the reflection in the northern margin is characterized by the broader and continuous of relatively higher amplitude. On the contrary, the southern margin in the profile shows chaotic reflections which generally occur due to presence of conducting material in the subsurface. The higher amplitude radar reflections are formed on account of the compacted Mesozoic rocks while the chaotic reflections are on account of energy loss due to clayey rich Tertiary rocks. The variation in the amplitudes of radar reflections from the Mesozoic and Tertiary rock is shown in Fig. 7.8b and c. Abrupt truncation of the two different types of radar reflections is noticed at a distance of 34 m in the profile (Fig. 7.8a, and d). The GPR profile shows that the SWF is near vertical fault near the surface that shows marked decrease in the amount of dip at depth with a southward dipping fault plane.
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Figure 7.8 (a) GPR profile taken from south of Halra dome with 40 MHz bistatic antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. (b) Oscilloscope of a single scan emanating from of the Mesozoic rocks (c) Oscilloscope of a single scan emanating from of the Tertiary rocks. (d) The boxed portion of (a) is shown in a Wiggle mode.

Site-III

The Adhoi anticline is the longest flexure in the entire South Wagad Flexure zone. The Adhoi anticline is characterized by the steeper southern margin which is due to the existence of the SWF in the southern margin. The fault is well exposed near the Adhoi village. Considering that fact we have taken a profile near the bank of Adhoi river lying west of Adhoi town (Fig. 7.2). The profile was acquired by 80 MHz bistatic antenna in point mode along S-N direction.

The upper ~3 m part of the profile is characterized by very high amplitude continuous radar reflections which is generally on account of good low conducting material like sand (Fig. 7.9a). As the profile is acquired near the right bank of Adhoi river it can be said that the high amplitude reflectors is representing the Quaternary alluvium deposited by the Adhoi river. Below the Quaternary sediments two different radar reflection phases can be identified. The southern margin is characterized by low amplitude reflections and the northern margin is characterized by the high amplitude reflections. Considering the field setting of the region the variation amplitudes of the radar reflections below the Quaternary cover is attributed to lithological contrast. The low
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amplitude reflections generally represent the Tertiary rock which is in conformity with the field setting and the high amplitude radar reflection represents the compacted Mesozoic rock (Fig. 7.9b, and c). The truncation of the high amplitude and low amplitude radar reflection is seen at a distance of \( \sim 20 \) m (Fig 7.9a and d). The present GPR study near the Adhoi suggests that the South Wagad Fault is a near vertical fault in the shallow subsurface.

![GPR profile](image)

**Figure 7.9** (a) GPR profile taken near the bank of Adhoi river with 80 MHz bistatic antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. (b) Oscilloscope of a single scan emanating from of the Mesozoic rocks (c) Oscilloscope of a single scan emanating from of the Tertiary rocks. (d) The boxed portion of (a) is shown in a wiggle mode.

Site IV

This site is located about 2 kms to the east of Adhoi town where thick Quaternary deposits abut against the scarp face which comprises steep southward dipping Mesozoic rocks (Fig. 7.2). At the southern edge of the prominent southward sloping surface over the
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Quaternary deposits, several man-made pits expose Tertiary rocks which consists of mostly shales and marls. The fault trace is therefore buried below the Quaternary sediments. The N-S profile acquired over the southward sloping surface over the Quaternary sediments with the help of 40 MHz bistatic antenna in point mode is shown in Fig. 7.10a.

Figure 7.10 (a) GPR profile taken from east of Adhoi town with 40 MHz bistatic antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. (b) Oscilloscope of a single scan emanating from of the Mesozoic rocks (c) Oscilloscope of a single scan emanating from of the Tertiary rocks. (d) The boxed portion of (a) is shown in a Wiggle mode.

The initial separation distance between the antenna was kept 2.25 m with the step size of 25 cm. The upper part of the profile is characterized by the high amplitude continuous to high amplitude inclined reflections represent the Miliolite sedimentary cover as observed in the field whose thickness increases upto 7-8 m towards the south. The inclined reflections are attributed to the foresets of the aeolian cross bedding developed in the miliolite deposits. The basal reflections in the profile can be easily
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separated out on the basis of variation in the nature of radar reflections. The northern margin below the Quaternary cover is characterized by the high amplitude radar reflection on the contrary the southern margin is characterized by the low amplitude radar reflection pattern. The variation in the amplitude of both reflection is depicted in the Fig. 7.8b and c. The variation in the amplitude from high amplitude to low amplitude in the radar reflection is only possible with the contrasting media property through which the radar wave propagates. Correlating the GPR data with the field observations, the high amplitude reflections are interpreted as the compacted Mesozoic rock while the low amplitude radar reflections are interpreted as the clay rich Tertiary rock. Truncation of high amplitude and low amplitude radar reflections is seen at a distance of ~ 30 m (Fig. 7.10a and d). This marks the faulted contact of the Mesozoic and Tertiary which defines the SWF. The shallow subsurface nature of the SWF at this site as reflected in the GPR data is inferred as a nearly vertical fault.

Site V

This site is located at the south of the Shivlakha dome (Fig. 7.2). The transect was located along a south flowing stream that arises nearby but exhibits a spectacular knick point as it flows across the SWF zone. The knick point height is ~4 m and is developed over last outcrop of well compacted Mesozoic sandstones, south of which river enters and incises the Quaternary alluvium of the flat terrain of the Samakhiali-Lakadia plain. The GPR survey was carried out in a barren agricultural field located on the left bank of the stream. The GPR survey was carried out with the help of 80 MHz bistatic antenna in point mode.

The prominent characteristic of the GPR profile is the presence of the high amplitude radar reflection whose thickness increases southward (Fig. 7.11a). This presence of the high amplitude continuous and wavy reflection is in conformity with the presence of Quaternary alluvium at the site. The basement rocks further below are characterized by the presence of thicker continuous reflections along with thin irregular or chaotic radar reflections. As the thicker continuous reflections are located on the northern side of the transect and therefore correspond to compacted Mesozoic rock while the irregular and chaotic reflections in the southern part are on account of Tertiary rock. The amplitude of Tertiary appears to be relatively more at this site which may be due to the presence of water (Fig. 7.11b, and c). The presence of a shallow pool of water at the base of the knick point in the stream confirms this inference. The truncation of the radar
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reflections marking the SWF is seen at a distance of \( \sim 19 \) m (Fig. 7.11a, d). The fault plane of the SWF at this site is inferred as vertical.

Figure 7.11 (a) GPR profile taken from south of Shivlakha dome with 80 MHz bistatic antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. (b) Oscilloscope of a single scan emanating from the Mesozoic rocks. (c) Oscilloscope of a single scan emanating from the Tertiary rocks. (d) The boxed portion of (a) is shown in a Wiggle mode.

Site VI

This site is located to the south of Chitrod dome. The Chitrod dome is largest of all the domal structures developed along the SWF. The geomorphic setting of the SWF scarp is similar to that at the previous site in the sense that a major part of the scarp face is covered by aeolian miliolite deposits. A prominent southward slope is developed over the surface of the miliolite deposits that is deeply dissected by gullies that further extend southward as steams into the Samakhiali-Lakadia plain. The SWF zone is therefore effectively buried by the Quaternary miliolite deposits. At the southern edge of the slope, Khanpar village is located where the Tertiary rocks are exposed in the \( \sim 7 \) m high vertical
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incised cliffs along a sharp entrenched meander of a stream that arises from the scarp face. The N-S profile was acquired with the help of 80 MHz bistatic antenna in a point mode.

![GPR profile diagram](image)

**Figure 7.12** (a) GPR profile taken from south of Chitrod dome near Khanpar village with 200 MHz antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. (b) Oscilloscope of a single scan emanating from of the Mesozoic rocks (c) Oscilloscope of a single scan emanating from of the Tertiary rocks. (d) The boxed portion of (a) is shown in wiggle mode.

The profile is 40 m long and depicts high amplitude radar reflection (Fig. 7.12a). The northern part in the profile is characterized by 2-3 m thick miliolite deposit over the basement which increased upto 10 m southward. A prominent hyperbolic surface in the upper part is on account of miliolite dune and the radar reflection marks the dunal topography over it ties the horizontal reflections over which the horizontal surface have been developed over which we acquired GPR profile. The upper part reflects the several phase of dunal activity which the area has undergone. The basement in the profile is easily recognized by the amplitude variations Fig. 7.12b and c. The northern part in the profile is characterized by the presence of continuous high to medium amplitude reflectors which is in contrast to the southern lying chaotic reflection. The amplitude variation is on account of lithological contrast. The high amplitude reflection represents the Mesozoic rock while the low amplitude reflection represents the Tertiary rock (Fig. 7.12b and
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c). Truncation of the radar reflection is seen at a distance of ~28m (Fig. 7.12a and d). SWF in this segment is characterized by near vertical reverse fault.

Site VII

This site is located in a agricultural field in front of the scarp face of the SWF near Mewasa (Fig. 7.2). The profile was taken perpendicular to the trend of the scarp face. The profile shown in the Fig. 7.13a was acquirec with 80 MHz bistatic antenna in point mode.

Figure 7.13 (a) GPR profile taken near Mewasa with 80 MHz monostatic antenna, location of site is shown in Fig. 7.2. Note the strong reflections emanating from the fault plane. (b) Oscilloscope of a single scan emanating from of the Mesozoic rocks (c) Oscilloscope of a single scan emanating from of the Tertiary rocks. (d) The boxed portion of (a) is shown in a Wiggle mode.

The profile in the upper part comprises of continuous high amplitude reflections whose thickness varies from 2 to 3m. These high amplitude reflections are from the alluvium cover over basement rocks in the shallow subsurface. The basement rocks are represented by high amplitude and low amplitude radar reflections. The high amplitude reflections lie close to the proximity of the Mesozoic ridge lying in the north thus represents the Mesozoic rocks. The contrasting low amplitude radar reflections in the southern part of the profile represent the clay rich Tertiary rocks (Fig. 7.13b and c). A sharp truncation in the reflection pattern is seen at a distance of ~19 m (Fig. 7.13a and d). This truncation of the radar reflection represents the SWF fault plane which is interpreted as a vertical fault at this site.